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FACIAL SINUSES OF DENTAL ORIGIN

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DISCHARGING sinuses of the face and neck from a source of dental infection are not of themselves a rarity, but nevertheless are not very common. Gurdin and Pangman (1953) review the American literature, which they say is almost entirely from dental and dermatological sources, and report 3 cases. They note that the recent literature on the subject was sparse. British sources are even more scanty.

This review of a series of cases is prompted by the length of time some of these had existed, by the unusual parts of the face and neck in which they can appear, and by the fact that few of the cases had apparently been associated with a possible dental source in the first instance. It is true to say that the variety of positions in which they can and do occur may not connect in one's mind with the possibility of a dental cause. Moreover, the identical tooth source of an infection resulting in a facial sinus produces a variety of possibilities as to the position of the external orifice in different individuals. (This will be noted particularly when comparing *Cases* 1 and 2.)

Bailey and Love (1956) describe a clinical entity of 'median mental sinus' which they say is often diagnosed and treated incorrectly. It is, they say, produced by a periodontal abscess when pus has tracked to the point of the chin. The patient has a discharging sinus on, or less frequently just below, the chin, but always in the midline.

This is only one position for a facial sinus, and whether it be on the point of the chin or submentally depends entirely on where and how the pus tracks. Inevitably, however, in this area they are due to infection associated with lower incisor teeth or canines, or buried roots of these.

The formation of an established discharging sinus can occur in two ways. First, there may be an acute abscess from the death of a dental pulp, and this may discharge to the buccal sulcus, or following a cellulitis have to be incised and drained externally; it may of course rupture spontaneously. The second possibility is that there may be a slow death of the dental pulp with a subacute or chronic infection, giving rise to quiet tracking of pus to discharge as before. In either case the pus will find its way to a surface by the path which offers least resistance. Most commonly it is through the muco-periosteum to the cheek sulcus, giving the appearance of a gumboil. It may, however, track to involve the fascial planes, affecting in particular the floor of the mouth, and result in a submandibular abscess.

If the source of infection is not removed, then a sinus will persist and discharge fairly constantly, or there may be intermittent subacute or acute phases with a flare-up and discharge alternating with quiescent periods. It is this latter type of case that is frequently diagnosed as an infected cyst of the face, particularly when it presents on the cheek.

The cause of infection with retained roots, whether buried or not, is obvious since they must then be considered as foreign bodies. The death of a dental pulp giving rise to an apical infection in an apparently sound tooth may be caused by a blow, caries extending to or near the pulp chamber, or by irritant fillings in the tooth—irritation being either chemical or physical.

The discharging sinuses of osteomyelitis of the mandible are not included in this presentation, although that is a disease associated with dental infection. If infected teeth or remnants of roots remain, or if remaining become infected, naturally there is bone infection, and a general osteomyelitis may well result as a spreading infection leading to thrombosis of vessels, necrosis, pus formation, and sequestration of bone.

These particular cases under consideration are mainly of a localized infection, either because the resistance of the patient is good or the virulence of the organisms low. That a spreading infection of bone has not occurred may be due to the absence of ill-timed interference in an affected area, either by extraction of teeth or the use of local anæsthetic in an infected area.

When thinking of a differential diagnosis for discharging facial or cervical sinuses, the following must be borne in mind in addition to infected teeth: carbuncle, boil, infected cyst (sebaceous, dermoid, implantation), actinomycosis, tuberculosis, foreign bodies, branchial fistula, thyroglossal fistula, parotid fistula, pre-auricular sinus. Each of course has its own particular peculiarities.

On looking through the index, one has recorded 9 cases of facial and submandibular sinuses from dental causes in the last two and a half years. Six are described at some length, since the histories make

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fascinating reading, each telling its own story. Of the three not recorded thus, one (L. D., female, 55) was due to a small fragment of tooth crown being embedded in the tissues of the lip in a road accident. In strange contrast to the others this was sent with a diagnosis of infection of the jaw from retained roots of teeth. The second (J. L., male, 75) was

FIG. 475.—Infected sebaceous cyst of cheek in a girl, aged 12 years. (Mr. J. P. Reidy's case.)

from residual infection in an edentulous mandible, probably initially of dental origin, but originally thought to be an infected cyst of cheek. The third (W. J., male, 41) was similar to the second, although a clear diagnosis of localized infection in an edentulous mandible had been established.

The following cases are all concerned with teeth or tooth roots in the mandible, though relatively it is not infrequent that a sinus of cheek is caused from a 'dead' maxillary tooth, especially a first molar. Bodenham and Bakewell (1958) currently report such a case simulating a cyst of cheek (*Fig.* 475). Each case-history will show confusion or lack of full examination at some stage, or it may be that the evidence had been masked. Radiographs of course are essential, but, as will be shown, confusion can easily arise even with expert interpretation. It cannot be overstressed that views taken from varying angles are frequently essential.

Having established the source or sources of infection, it is possible to do a primary excision of the skin scar and sinus tract, or merely perform curettage. Removal of the tooth, teeth, or roots which are the infective agents is essential at this point if a breakdown is not to occur. Antibiotics can be used with discretion, though are far from essential in every case.

Many patients have been subjected to incorrect, lengthy, and harmful treatment on a mis-diagnosis, and an instance is quoted below which should be salutary. This case has not been seen by the writer, but its authenticity is not to be questioned. It concerns a girl aged 20 years who presented with a lump in the tissues of the right cheek of two months' duration. At that time it did not involve the skin, and was a circumscribed nodule, felt better from within the mouth, and was painless. It was thought that it might be an ectopic mixed salivary tumour. Sialogram was normal, as was a radiograph of the jaw. About a month later it was larger, the skin over it being discoloured and adherent. Induration appeared to extend from cheek to maxilla across the bucco-alveolar sulcus—still painless and only slightly tender. It was now thought to be a chronic infection. It was slightly larger and softer after a course of penicillin and sulphamezathine for five days, and a few days' aureomycin. She was seen at this juncture by another surgeon, who thought that it might be a tuberculous infection, and was put on streptomycin and P.A.S. After a week the induration between the cheek and gum had definitely resolved and the mass was soft, but tending to point, more on the skin surface. Aspiration produced some thin yellow pus, which not surprisingly was sterile. The abscess was incised and evacuated, and a narrow track was found to run through the cheek from a small subcutaneous abscess cavity to the maxilla in the region of the premolar teeth. It was now felt that sepsis in the region of the teeth could be the cause of the trouble, and would continue to be so, with the possibility of an external sinus. At this stage, radiographs of the teeth showed a devitalized and root-filled upper second premolar which was obviously suspect, and it was extracted. The first molar appeared to be all right at this time but the radiographs, though good, were not particularly helpful. Three months later there was still a discharge from the face and the first molar was extracted; it had a dead pulp and was obviously the source of infection. Since then there has been no discharge.

This was obviously a trying case from all aspects and presented difficulties all along the line. It is just this type of case, however, that merits closer investigation before resorting to a variety of treatments without a firm diagnosis.

CASE REPORTS

Case 1.—A. C., a male aged 12 years, had a discharging submandibular sinus which had been present for over a year (*Fig.* 476). As will be seen, it is fairly far forward in the submental region and to the left of the midline.

The previous history was that of a dental abscess treated by submandibular incision and drainage with extraction of a tooth. Later there had been a breakdown and further discharge. The sinus was explored, and since the discharge persisted, was explored once more. These three separate operations and the chronicity of the process combined to form the unsightly scarring and sinus with which he presented. The parents, not unnaturally, were worried, although their son was fit and in good general health otherwise.

This case had of course been investigated thoroughly, but the condition still persisted and a fresh batch of investigations were justified.

Hæmoglobin, 90 per cent. *E.S.R.*, 2 mm. fall in the first hour.

Radiography: Especially rotated P.A. views for the anterior and canine region of the left side of the mandible where the source of the original abscess was supposed to be (*Fig.* 477): although this reveals the pathology, it was not appreciated at first.

Swabs: On admission: Culture—*Staph. aureus*, sensitive to chloromycetin; resistant to penicillin, streptomycin, terramycin.

Five days later: Direct film—no evidence of actinomycosis, no A.F.B. Culture - a very slow-growing variety of anaerobic streptococcus, sensitive to all antibiotics, negative for tubercle.

Histology of the exuberant granulations at the sinus orifice: Portions of vascular non-specific inflammatory granulation tissue. This is lined in places by squamous epithelium. No evidence of tuberculosis or tumour.

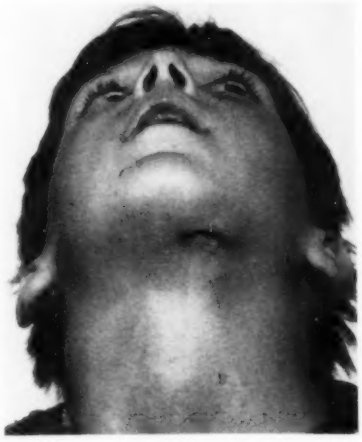

FIG. 476.—*Case* 1. Submandibular sinus discharging for over a year in a boy aged 12 years.

A further exploration was embarked upon, but it was not until the child was on the operating table that previous radiographs which had been obtained and which undoubtedly were available at previous investigations, were more thoroughly perused. One of these (*Fig.* 478) shows

FIG. 478.—*Case* 1. Radiograph shows clearly that the erupted first molar is the source of infection, with a path of translucency passing down and forward to the lower border of the mandible.

quite clearly that the mandibular left first molar was the infecting agent, that it was a 'dead' tooth, and that there was a broad defined translucent zone in the mandible. This is present in the radiograph *Fig.* 477, but certainly is more obvious when one has seen another view. The X-ray film from which *Fig.* 478 was prepared was overdeveloped and reading was only possible in certain lights (*see also Fig.* 479).

A probe passed into the sinus went up and back to the lower medial border of the mandible. With this in place, the scar and sinus tract was excised in an ellipse. A defect in the mandible was encountered, and this was curetted free of old tough granulation tissue; a narrow funnel-shaped cavity led from here. The tooth was extracted and the probe could then be passed through the now clean bone cavity from below and into the mouth through the tooth socket. The external wound

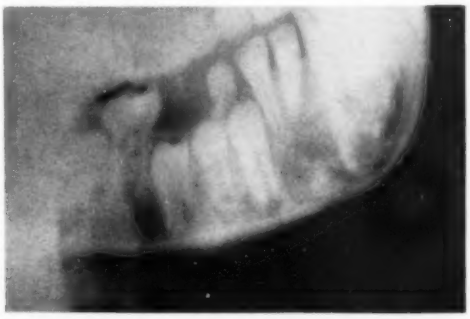

FIG. 477.—*Case* 1. Rotated postero-anterior radiograph of left side of the mandible anteriorly. Apart from a deciduous canine about to be shed, bone structure appears normal in that area. The translucent patch at the erupted first molar could be airway, and in the radiograph proper the shadow appears to continue in soft tissues.

FIG. 479.—*Case* 1. AB on a lateral radiograph of right mandible marks the anterior extremities of the airway. Note how this appears as it crosses bone and continues into soft tissues. A rotated view would project this more anteriorly, and simulate the appearance of the shadow as in *Fig.* 477.

edges were undermined and closed in layers without a drain.

There was some elevation of temperature on the following day, and a six-day course of achromycin with becosyn was initiated. Healing was uneventful.

Histology of the two pieces of tissue sent for section was as follows: (*a*) sinus tract lined by fibrous granulation tissue; (*b*) fibrous non-specific inflammatory granulation tissue.

It is quite certain that the myth of the abscessed tooth having been removed was the red herring.

An abscessed deciduous tooth may have been removed then, but it certainly was not the causal agent.

The sequence of events as quoted in *Case* 1 is bound to occur when submandibular swellings are incised and drained without an attempt being made

FIG. 480.—*Case* 2. Discharging sinus in a boy aged 19 years.

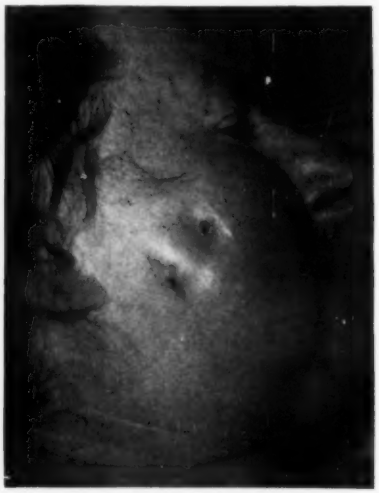

FIG. 482.—*Case* 3. Shows two drainage sites—one in the pre-auricular scar line, and another more recent.

to find out if there is a dental cause, or, if a dental cause is established, when the patient is not directed to the proper quarter. In most hospitals, nowadays, whether general or with special units, the acute and gross facial swellings do seem to get directly to the Consulting Department of Dentistry in the first instance. Happily, the number of these cases has decreased markedly over the years, but there is still a significant proportion of admissions of acute abscesses of the face and neck from dental causes.

Of course, as has been mentioned, it is quite possible for a sinus to develop without there having been any large initial swelling; this where a chronic dental infection from a 'dead' tooth has produced pus which has tracked quietly through bone with erosion, and through periosteum, and had found the line of least resistance and eventually reached the surface. An example of this will be seen in the following case:—

Case 2.—J. G., a male aged 19 years, was referred from the Dermatology Department with a discharging sinus on the right side of his face. It had been present for five months and had originally been regarded by his doctor as acneiform (*Fig.* 480). No pain was attached and no great swelling had been present. There had been some recent 'itching'.

Swab: Gram film, numerous pus cells and Gram-positive cocci. Culture, scanty growth of a paracolon.

FIG. 481.—*Case* 2. Radiolucent area denoting infection of bone at the anterior root of the first right molar.

Radiographs sent with the patient showed the mandibular right first molar to be the culprit (*Fig.* 481). Precisely the partner of the tooth in the first case.

At operation, curettage of the sinus track only had been envisaged, along with removal of the tooth. This was done, the sinus track being followed down and back to the lateral aspect of the mandible. The facial wound now looked so ragged that an immediate excision and suture was performed in layers. No antibiotic was used and the stitches were removed on the third day.

Case 3.—F. P., a female aged 61 years, had a facial swelling which for two weeks was regarded as mumps. It persisted and aureomycin failed to give a remission. A month later there was some discharge intra-orally and she was admitted to hospital, where external drainage after incision was done. (Possibly it was regarded as a parotid abscess.) There was marked improvement then, but two weeks later the swelling recurred. Kaolin poultices were then applied, and penicillin started. The abscess burst on the cheek (*Fig.* 482), and continued to drain. Homœopathic treatment was sought and tried for the next month but produced no real improvement. She was, however, during this period, X-rayed, and a buried tooth was seen in the films of her mandible (*Figs.* 483, 484). It was at this stage that she came into the writer's hands.

On examination, there was a red firm swelling over the right ascending ramus of the mandible, with an incision scar pre-auricularly and a second discharging sinus anteriorly (*Fig.* 482). Slight trismus was present, and she was edentulous other than a retained, inverted wisdom tooth lying below the sigmoid notch and partly in the coronoid process of the right side of the mandible. There appeared to be an infected bone cavity present, though it is always difficult to explain how a tooth can lie dormant for so long, completely buried, and then become infected.

Swab: Gram film, pus cells and streptococci. Culture, anaerobic streptococci, sensitive to penicillin, streptomycin, terramycin, and chloromycetin.

At operation, an intra-oral approach was made to the ascending ramus, and bone was removed from around the tooth, which was then divided to allow easier removal in two segments. A corrugated rubber drain was sewn in to emerge through the wound in the mouth (*Fig.* 485).

The external sinuses were curetted. The drain was removed at 48 hr. and a dead space packed with BIPP on ribbon gauze.

There was a period of mental anæsthesia which recovered, but which, nevertheless, was difficult to explain since the nerve-trunk was in no way involved at the operation site. The final condition remaining six months later was a 1-in. depressed scar from the first facial incision (*Fig.* 486). She was later offered and accepted scar excision, and this was performed by Mr. D. A. Kernahan under local anæsthesia as an outpatient.

FIG. 483.—*Case* 3. Postero-anterior radiograph of mandible, showing inverted wisdom tooth in right coronoid process.

FIG. 485.—*Case* 3. Corrugated rubber drain from bone cavity in ascending ramus of mandible to mouth.

Moody (1955) reports a case somewhat similar to this of an infected dentigerous cyst; it lay rather more posteriorly and lower in the ascending ramus of the mandible, with the wisdom tooth actually visible in the sinus orifice, which appeared below and in front of the ear.

Case 4.—A. S., male, aged 51 years. It is really hard to believe, but a fact, that this man had a discharging sinus below the left angle of his mandible for over 40 years (*Fig.* 487). At the age of 5 or 6 he had had extractions. It is obvious that he then had an acute osteomyelitis of his mandible, either because of the extractions, or necessitating removal of teeth from the left side of the jaw.

He was in hospital for eight months with swellings and discharges—quite an understandable position in 1914 or thereabouts. He then attended hospital for the next five years for weekly dressings. There is evidence of a surgical exploration submandibularly of the left angle in 1924, but again there was breakdown within three weeks. This now leaves a depressed scar which is puckered, and with the sinus orifice at its superior end. Apparently there was no further treatment except for X-ray investigation periodically.

He now presented, wishing to get rid of this nuisance. Photographs show the typical results of an early occurring

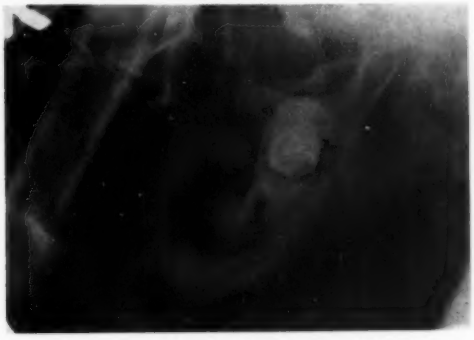

FIG. 484.—*Case* 3. Lateral radiograph of mandible showing inverted wisdom tooth in right coronoid process.

FIG. 486.—*Case* 3. After healing and before scar excision.

osteomyelitis. This is evident in the asymmetry and lack of development (*Figs.* 488-490).

The left side of the mandible is underdeveloped, and has not grown fully downwards or forwards, and this is the primary defect. The right side has grown on to

Swab: Culture, scanty growth of *Staph. aureus*, *Staph. albus*, and diphtheroids. Sensitive to all antibiotics.

At operation, the excision included the old scar and the sinus track. Exposure was deepened to the lower border and periosteum freed and retracted. This allowed

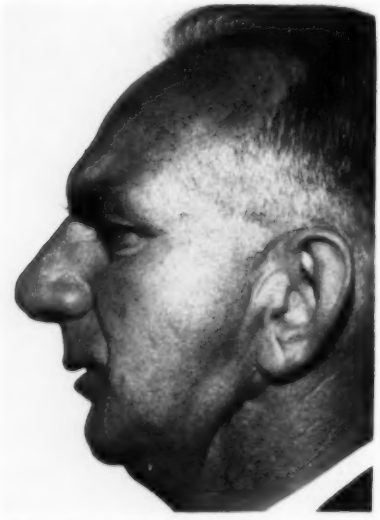

FIG. 487.—*Case* 4. Scar and discharging sinus present for over forty years in a man aged 51 years.

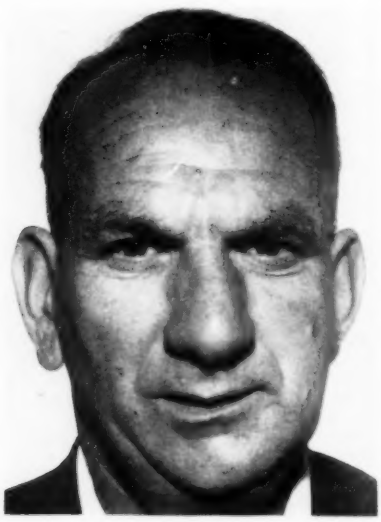

FIG. 488.—*Case* 4. Asymmetry from old osteomyelitis.

FIG. 489.—*Case* 4. Asymmetry from old osteomyelitis.

FIG. 490.—*Case* 4. Asymmetry from old osteomyelitis.

compensate for the lack of growth on the other side. This gives the flattened appearance of the right side of the face, and the position of the symphysis to the left of the midline.

Radiographs further show a cavity in the lower border of the mandible near the left angle, with a definite separation of what might be a sequestrum, but which had the density of a foreign body of dental structure (*Figs.* 491, 492; also seen in *Fig.* 479).

the removal from a smooth-walled cavity of a malformed single-rooted denticle. It had a capsule which was the remains of the enamel organ (*Fig.* 493). The wound was closed in layers after undermining of skin edges and without drainage. A six-day course of penicillin was started with the premedication.

There has been no subsequent breakdown, and he says that he has "never felt better in my life" (*Fig.* 494). He does not wish any corrective jaw operation and this is

not now particularly indicated, so that there remained only the problem of constructing satisfactory dentures—not an inconsiderable one. He has never had satisfactory dentures, and the basic asymmetry and maldevelopment make this a not very easy task.

Cases 5 and 6 are examples of what Bailey and Love (1956) describe as 'median mental sinus'.

FIG. 491.—*Case* 4. Postero-anterior radiograph showing foreign body near left angle of mandible.

Case 5.—K. H., female aged 46 years. This lady was referred by the Department of Dermatology with the established diagnosis of a discharging sinus to the chin due to buried roots. She had been treated for a boil or a carbuncle four or five months previously; this by oral penicillin and kaolin poulticing. The swelling had soon discharged and settled, but there continued a slight discharge every two to three days.

On examination, there was a depressed scar in the centre of the chin, with a pustule associated. The patient

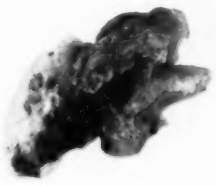

FIG. 493.—*Case* 4. Deformed tooth or denticle with capsule. (× 2.)

was edentulous, and had been wearing full dentures for seven years. Radiographs showed two roots to the left of the midline of the mandible—the source of the infection (*Fig.* 495).

Curettage of the sinus track was followed by excision and suture. The two roots were removed, and three days later the facial stitches were removed. A photograph shows the site after 2½ months (*Fig.* 496).

Case 6.—W. B., a male aged 49 years, had a three-year history of an intermittent discharge from the mental region, and had a retained root in the lower right canine

FIG. 492.—*Case* 4. Lateral radiograph of left mandible with foreign body in bone cavity at lower border. Underdevelopment of angle.

FIG. 494.—*Case* 4. Three months after closure of the fistula.

area (*Fig.* 497). With the first appearance of signs, he had a cellulitis of chin treated with penicillin. Two years later he had an operation for drainage of a carbuncle, and a year after that a discharge of pus.

Although there was a sinus present, the pus was rather under tension, and more of an acute abscess in nature. It was opened and drained, a small silkworm gut drain being used. The root was removed after removing bone from around it, and the infected area of bone cleared.

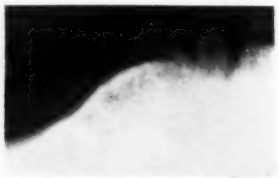

FIG. 495.—*Case* 5. Intra-oral radiograph showing two retained roots in the incisor region of mandible.

FIG. 496.—*Case* 5. Two and a half months after excision of sinus and removal of roots.

DISCUSSION

The formation of facial and submandibular sinuses from dental sources has been described and 9 cases presented. The method of treatment is not in doubt once a diagnosis has been established, the treatment in itself presenting no great difficulty. Although the condition is not serious, it can be alarming to the patient, to whom at least the nuisance value may be extreme.

While the presentation of a discharging sinus inside the mouth is commonplace and immediately associated with teeth, this cannot be said always for the presence of an external discharge, especially on the face. It could be said that some have a blind spot in diagnosis in this direction, which is rather remarkable considering the number of teeth still removed as potential sources of infection.

Cysts of the face are not always the easiest of things to deal with, especially if they become infected, which is the usual reason for treatment being sought, and a recurring cyst-like swelling is possible in the cheek. If there is a connexion with a dental source of infection, one can usually feel an indurated band of attachment to the jaw, along the track. This has been described as being rather cord-like. A cyst or infected cyst should be free in the substance of the soft tissues, and not bound down as in the case of a sinus.

The sinus tracks do not necessarily take direct routes to the nearest skin surface, and are frequently longer and more divergent from the source than one might expect. Grotting (1956) reports a sinus discharging on the side of the nose, above the naso-labial fold, from an infected dental cyst associated with the upper lateral incisor; and also a case of a discharging infected dermoid cyst in a very similar position. He also reports 2 cases of submental sinuses, one from infected lower incisor teeth and one from an infected dermoid cyst of tongue in an infant. Poultice application will, of course, be a determining factor in some instances. Gravity may have some effect, but in general, it is the density of the tissues, their attachments, and the planes of separation in particular which will determine the track, as well as the arrangement of the muscle groups.

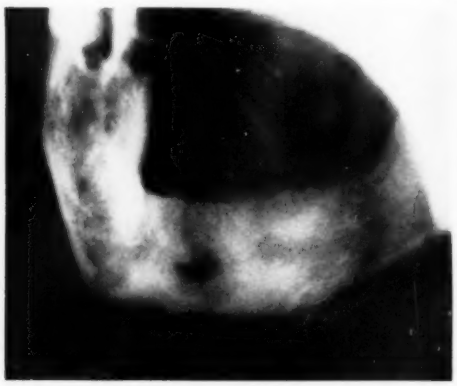

FIG. 497.—*Case* 6. Rotated postero-anterior radiograph showing infected retained root in canine region of right mandible.

The comments of Bailey and Love (1956) on the frequency of incorrect diagnosis and treatment have been amply justified, though the latter occurs only because of the former. Kwapis and Baker (1956) review 13 cases all under the age of 35 years: their experience is that often there are multiple unsuccessful attempts at therapy, frequently with the topical application of drugs. They also note that in the developing stages there may be a resemblance to a furuncle, but when rupture occurs, the acute inflammatory signs decrease.

All the cases described by the writer involve sepsis in the mandible, but according to Greer Walker (1958), it is by no means unknown for upper teeth to be the cause of a sinus on the face, especially the first molar and sometimes the canine. Hayton-Williams (1958) confirms this and has noted 3 cases. There is, of course, no real reason why any tooth in the head could not be the causal agent. Green (1924) reports an unusual case of a 20-year-old male with a swelling along the side of the nose and a sinus over the lacrimal sac that had discharged intermittently for six years. Chronic dacryocystitis was suspected, but the cause was found to lie in an abscessed upper canine tooth. The apex of this tooth of course lies very high indeed.

Radiographs can be dangerously misleading at times, although they are essential. Emphasis must be laid on the necessity of having different angles of view, and also, on occasion, the desirability of having different views taken from only slightly varying angles. Although intra-oral radiographs have been little used in illustration, they are nevertheless essential in amplification, and to show earlier and obscure changes more accurately. The extra-oral views used here are for the sake of orientation, and all show quite clearly radiolucencies of advanced destruction from infection.

Treatment will involve curettage of the sinus track and extraction of the tooth or removal of the root, along with removal of any infected granulations associated with either. Quite simply, this is removal of the source of the infection, and may be all that is required. On occasion it might be necessary for a plastic surgeon to do an excision subsequently should there be an unsightly terminal scar: at least six months should elapse before this is considered, to allow for maximum improvement. Alternatively, as has been described in several cases, it is quite permissible to suture after doing a primary excision of the scar and tract, provided that it is certain that the infecting agent is totally eliminated at that time. This has much to recommend it in certain cases.

SUMMARY

Sinuses discharging to the face and neck from dental sources of infection are described and discussed. A series of 9 cases is reported; 6 of these are dealt with in some detail. The literature is reviewed.

I am particularly indebted to Mr. D. Greer Walker for passing on *Case* 1, which was referred to him after three explorations; to Dr. C. L. Greenbury and Dr. H. J. Harris for the bacteriology and histology; to Dr. R. Spalding Smith and Mr. Skeer for the radiology and radiographs; and to Mr. Mason for the photography.

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SOME OBSERVATIONS ON GASTRIC CYSTS

BY J. THOMPSON ROWLING, LEICESTER

CYSTS of the stomach are rare, and their symptoms and signs variable. Although it is sometimes possible to make a pre-operative diagnosis, the majority present at laparotomy, or as incidental findings in the post-mortem room.

Large cysts of the stomach, as distinct from mesenteric cysts which are of lymphatic origin, are always associated with reduplication of the alimentary canal. Multiple small cysts are sometimes seen in association with adenomyomata in the pyloric area. Multiple cysts have also been reported as occurring throughout the stomach in association with chronic gastritis (Scott and Payne, 1947). Each type of cyst has, therefore, a different origin and distinctive pathology.

ADENOMYOMATOUS CYSTS

Adenomyomata of the stomach are not true tumours, but islands of heterotopic gastric or duodenal mucosa which may contain pancreatic tissue and are of embryonic origin (Winston Evans, 1956). They were first described by Stewart and Taylor (1925), who regarded them as true neoplasms.

Although small cysts are nearly always seen in these swellings, it is only rarely that these are large enough to present as a cystic tumour to the naked eye—a rather surprising fact in view of the adenomatous epithelium present.

They are commonly seen at the pyloric end of the stomach, but also occur in the gall-bladder and elsewhere in the intestinal tract (Clarke, 1940). It is unusual for symptoms to develop. At times they are mistaken for early carcinomata of the pylorus when seen at laparotomy. Malignant change is very rare, although Nicholson (1950) has cited three examples.

In general these swellings are of little clinical significance, and cyst formation associated with them is rare.

MULTIPLE CYSTS ASSOCIATED WITH GASTRITIS

Multiple diffuse cystic hyperplasia is occasionally seen associated with the more severely destructive types of gastritis (Shaw, 1951). In the case described by Scott and Payne (1947) the stomach was the seat of multiple small cysts, about the size of peas, extending from the pylorus to the middle of the body of the stomach.

It is suggested that these cysts originate by erosion of the gastric mucosa which involves the gland outlets, eventually resulting in multiple retention cysts (Myers, 1948).

The clinical picture is that of the associated gastritis. The condition is extremely rare.

REDUPLICATION CYSTS

Large solitary cysts of the stomach have been reported from time to time, the first being described by Staehelin and Burckhardt in 1909. Other early cases were reported by Wendel (1911), Lyons (1916), and Cabot (1928), but even by 1952 Lyall was only able to collect 8 cases from the literature. Since then the condition has been described more frequently, more particularly since it has been recognized that these cysts are homologous with reduplications elsewhere in the alimentary canal. This association, together with an appreciation of the pathology, was first described in a noteworthy paper by Ladd and Gross in 1940.

Morbid Anatomy.—Reduplications of the alimentary tract occur from the upper œsophagus to the rectum, and their occurrence in the stomach is therefore fortuitous. They may extend upwards from the stomach into the mediastinum closely applied to the œsophagus (Goon, 1953), or downwards through the pylorus, as in the case here described.

The three essential features of the pathology of the cyst are that it is in close proximity to the stomach, the wall of the cyst being contiguous with the stomach wall; that it is surrounded by a smooth-muscle coat, fusing with the muscle of the stomach; and that it is lined by alimentary epithelium. The latter is not always of gastric type, but may be colonic, ileal, or jejunal. Conversely, gastric mucosa has been described in reduplications of the rectum, and elsewhere (Ladd and Gross, 1940).

The blood-supply of the cyst is that of the adjacent stomach, and there is no plane of cleavage between the two. Communication between the cyst and the stomach has twice been described and it occasionally occurs in reduplications elsewhere (Gjorup, 1933; Nolan and Lee, 1953).

The size of the cyst is variable, being on occasions larger than the stomach itself, or as small as a plum. In shape, the cysts usually follow the contour of the stomach, but are sometimes globular.

Two pedunculated cysts have been recorded. In each case the cyst extended outwards into the peritoneal cavity (Gray and Wood, 1938; Sheppard and Gilmour, 1945).

Origin.—The origin of reduplications remains obscure. In the six weeks' embryo the alimentary tract becomes a solid structure, the lumen being occluded by developing epithelium. Later, vacuoles develop along the tract which coalesce to form a continuous lumen. The persistence of a vacuole which fails to fuse with the developing lumen has been held to be the origin of a reduplication (Johnson, 1910). Keith (1933) suggested that these vacuoles might fail to fuse in the line of the lumen of the gut, thus reduplicating it.

Lewis and Thyng (1907) describe transient diverticula forming during development of the normal embryo, and Bremer (1944) suggested that reduplication could arise from detachment and growth of the cells at the extremity of such a diverticulum. Ladd and Gross (1940) held that simple occlusion of the mouth of such diverticula would suffice.

The presence of normal intestinal mucosa suggests that the cysts originate at an early stage of embryonic life, but none of these theories explains the presence of colonic and other epithelium in gastric cysts.

It is difficult to believe that epithelial tissue could migrate to the site of the cyst from elsewhere in the alimentary tract at any stage of development, and the intimate fusion of the cyst with its associated bowel excludes the possibility of migration of the cyst itself. It is therefore suggested that these cysts originate from cells whose development is arrested at a very early stage, retaining their potentiality for developing alimentary epithelium of any type. Reduplications are usually seen in infancy or childhood, at a time when growth stimuli are still very active. We have no evidence as to whether these cysts develop just before they become apparent clinically, or whether they are present at birth and not detected until symptoms develop.

Clinical Features.—Reduplications can become apparent at any age, but are more common in infancy and childhood. In the 18 cases described by Ladd and Gross from the Children's Hospital, Boston, U.S.A., the ages ranged from 2 weeks to 9 years. Shaw's case was aged 67 years; Deaton and Pautler (1952) describe a case in a man aged 49 years, but the majority of reported cases are in children. Boys and girls are equally affected.

The presenting symptom is usually pain, which is commonly associated with intermittent vomiting. If the cyst lies in the pyloric area, the pain may be colicky and associated with peristaltic movements attempting to pass the cyst into the duodenum. Although episodes of gastric obstruction occur, symptoms of pyloric stenosis have not been recorded.

In cysts situated in the body of the stomach, the pain is of a more constant, steadier type, and is frequently mistaken for dyspepsia in the older patient.

Cysts extending into the mediastinum may produce dysphagia and œsophageal regurgitation.

Pain is often absent altogether, and it seems probable that many cysts are present for a considerable time before the onset of pain or vomiting leads to their recognition.

Vomiting is common. Small amounts are usually vomited, commonly food that has recently been taken, and this may be frequently repeated during attacks of pain.

Other symptoms are rare.

In practically all cases the cyst can be palpated as a smooth, rounded, slightly mobile epigastric mass. Tenderness is variable, but there is no rigidity of the abdominal wall and guarding is not marked.

The presence of the mass, together with colicky pain and vomiting, often results in the diagnosis of an 'atypical' intussusception being made, and in view of the rarity of gastric cysts this is reasonable enough.

There is no alteration in bowel habit, and the stools are normal.

Apart from the presence of the mass, physical examination is essentially negative.

The presence of a soft-tissue shadow on straight radiography of the abdomen has been described,

and reduplication has also been demonstrated by barium-meal examination (Kiesewetter, 1957).

A barium-meal examination may show a somewhat marked filling defect, as of a leiomyoma or submucous lipoma.

Complications.—Torsion, malignant change, and hæmorrhage from an associated peptic ulcer have been described.

Torsion of a large pedunculated cyst is described by Sheppard and Gilmour (1945). A pre-operative diagnosis of twisted ovarian cyst was made, but at laparotomy a gastric cyst 11 cm. × 10 cm. × 7·5 cm. was found, the pedicle being attached to the greater

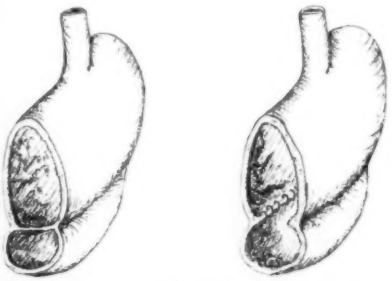

FIG. 498.—Large reduplication cyst, showing the suggested method of treatment.

curvature. The cyst was resected and recovery was uneventful.

Only one other pedunculated cyst has been described: that of Tchernisher in a paper by Gray and Wood (1938).

Malignant change has been recorded in one case (Mayo, McKee, and Anderson, 1955). The patient was a woman aged 64 years who presented with anæmia and an epigastric mass, a diagnosis of carcinoma of the antrum being made. At laparotomy a rubbery mass in the antrum was resected, which proved to be a gastric cyst in the wall of which was a polypoid malignant epithelial tumour. Her condition one year after operation was satisfactory.

Hæmorrhage associated with a gastric cyst in a man aged 49 years has been described by Deaton and Pautler (1952). No ulceration of the stomach was found, but the patient had had a hæmatemesis requiring transfusion of 4 pints of blood two years previously, with continuing dyspepsia until gastrectomy was undertaken.

Shaw (1951) records a case of gastric cyst in a woman aged 67 years, associated with a penetrating lesser curvature ulcer. No gross bleeding occurred in this instance.

Treatment.—This is essentially surgical. Two factors must be borne in mind: first, the cyst is intimately associated with the stomach, having a common muscular wall, and cannot therefore be shelled out after the manner of other cysts, as there is no plane of cleavage between it and the stomach; and, secondly, it has a common blood-supply with the stomach.

There is no doubt that cysts in the pyloric part of the stomach should be treated by partial gastrectomy, of the Billroth I type. The operation is generally easy in these cases, as the duodenum mobilizes well and adhesions are absent. The mortality is low, even in children, and providing a reasonable part of the stomach remains, the subsequent disability is very slight.

Large cysts of the body of the stomach and those extending up into the mediastinum present a greater problem. Total gastrectomy has been performed, but the operation is a mutilating one, and the mortality high, bearing in mind that the condition is essentially a benign one. It is debatable whether this is justifiable, at least at the present time.

Marsupialization to the surface has been performed, with variable results. Ladd and Gross (1940) had one satisfactory result in a girl aged 7 years (Case 5). Goon (1953) marsupialized a cyst in a child which resulted in a chronic discharging fistula. The operation is relatively easy and safe, but on theoretical grounds, at least, it is not a logical solution.

Bearing in mind the fact that the cyst has a common musculature with the stomach, and that its lining usually consists of normal gastric mucosa, the operation of choice should be division of the muscular septum between the two cavities, resulting in an approximately normal stomach of larger capacity. Clearly, the division should extend over the whole length of the cyst, otherwise a diverticulum will be formed with resultant stagnation of its contents.

It is suggested that an anterior gastrotomy be performed, and that the septum between the cavities be incised under direct vision, hæmostasis being secured by a running suture along the circumference of the confluence of the cavities, approximating the gastric mucosa to the mucosa of the cyst. (*Fig.* 498.) The risk of malignant change seems small enough to justify this procedure, and, should it prove unsuccessful, subsequent surgical attack should not prove any more difficult than before.

In those rare instances where the cyst is pedunculated excision presents no problems.

CASE REPORT

The patient was an intelligent boy of 11 years, admitted to the Leicester Royal Infirmary on Oct. 18, 1957.

Since the age of 8 years he had had attacks of 'tummy ache' associated with vomiting, lasting one or two days

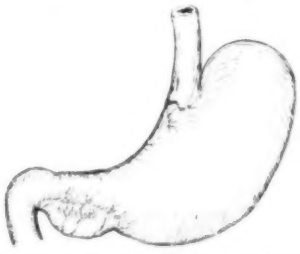

FIG. 499.—Sketch of the cyst, as seen at operation.

at a time, and occurring about three or four times a year. These were never severe and he had never been admitted to hospital previously.

Apart from this he had been quite well until the morning of his admission, when he developed severe

epigastric pain of sudden onset, associated with frequent vomiting. He went to bed and vomited nine times that morning. After each bout of vomiting his pain became worse and was accompanied by epigastric tenderness. His bowels had been moved normally that morning and were previously regular. His appetite had been good. At the time of his admission his condition had improved somewhat and his mother questioned the propriety of his admission to a ward of ill patients. This anomaly was subsequently corrected.

On Examination he was still having fairly severe epigastric pain, although this had improved a good deal since its onset. He was a healthy looking child of normal nutrition. The abdomen was soft, although there was some voluntary guarding in the epigastrium, associated with tenderness there.

Fig. 500.—Naked-eye view of the specimen.

A smooth mobile mass was palpable, just to the right of the midline, above the umbilicus. The liver and spleen were not enlarged, no free fluid was present, and the rest of the abdomen was normal to palpation. Rectal examination was negative. His temperature was 99° and his pulse 82.

At Operation the same night the abdomen was opened through a right paramedian incision. A soft, cystic mass was found in the substance of the stomach wall, at the pylorus, the size of a plum. It extended upwards into the wall of the antrum and distally into the first part of the duodenum, the veins of Mayo passing over the centre of the swelling (*Fig.* 499). Several enlarged nodes were seen between the duodenum and pancreas distal to the swelling. The other viscera were normal. The duodenum was mobilized and the antrum, pylorus, and first part of the duodenum were excised, continuity being restored by anastomosis, after the manner of Billroth. The appendix was removed.

Recovery following this was uneventful and he was discharged to a convalescent hospital one week later.

When last seen, ten weeks after operation, his condition was satisfactory and he was free from symptoms.

Pathological Report on the Cyst.—Specimen consists of portion of stomach 6 cm. in length, containing in its wall a cyst 5 cm. in diameter (*Fig.* 500). This cyst lies between the middle circular layer of muscle of the stomach and the outer longitudinal layer. There are many markedly dilated blood-vessels under the serosa and there is subserosal œdema and round-cell infiltration. The cyst is lined by gastric mucosa showing both peptic and mucoid acini. Some of the acini are dilated to form cystic spaces. No Brunner's glands are present. There are many lymphoid follicles present and the mucosa is infiltrated with polymorphonuclears and eosinophils. There is considerable round-cell infiltration of the œdematous submucosa of the cyst and the blood-vessels in the vicinity of the cyst contain many polymorphonuclear pus cells indicative of leucocytosis (*Fig.* 501). This is a heterotopic piece of gastric mucosa. It is not a neoplastic lesion.

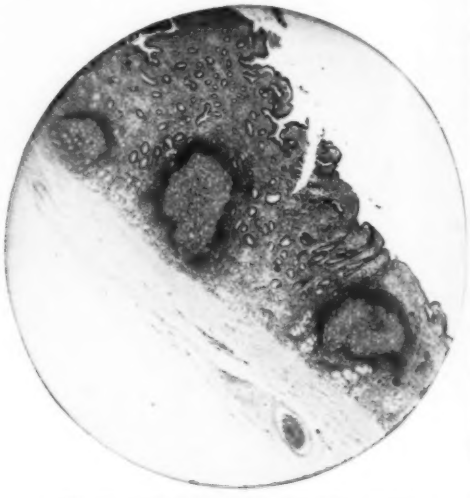

Fig. 501.—Histological appearance of the cyst wall.

DISCUSSION

This case does not present any unusual features, but typifies the common findings in the condition.

The colicky pain of which the child complained was almost certainly due to attempted passage of the cyst along the duodenum. His vomiting was probably in part reflex and in part obstructive in nature.

It seems possible that the tension of fluid within these cysts varies from time to time and this has been held to account, in part, for the pain they produce. This variation may have been responsible for the complete freedom from symptoms in between his previous attacks of pain.

Diagnosis is seldom made pre-operatively on account of the great rarity of the condition. In this case it was thought that the most likely cause of his condition was an atypical intussusception which, while giving rise to a mass and colicky pain, had not produced the passage of blood or mucus rectally. In this instance the cyst, masked by slight guarding, felt very similar to the smooth rounded mass of an intussusception in the right transverse colon.

Treatment presented no difficulty. The cyst involved the first part of the duodenum, as well as the pyloric antrum, which necessitated its resection, but was a relatively easy operative procedure.

Up to the present the result has been satisfactory.

SUMMARY

The types and clinical features of gastric cysts are reviewed.

The theories of their causation are discussed, together with the methods of surgical treatment.

A case of reduplication cyst of the pylorus, extending into the antrum and involving the first part of the duodenum, is reported.

Acknowledgements.—I would like to thank Mr. E. R. Frizelle for allowing me to treat and record this case; and also Mr. D. McGavin for his help with this paper. I am indebted to Miss Zagorska and Mr. Brooks for the illustrations; and to Dr. E. M. Ward, of the Department of Pathology, Leicester Royal Infirmary, for the pathological report and the photographs.

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EOSINOPHILIC GRANULOMA OF THE GASTRO-INTESTINAL TRACT

REPORT OF TWO CASES

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EOSINOPHILIC granuloma of the gastro-intestinal tract is very rare. It can develop in any part of the gut. Brunner (1951) reported a case in which a part of the oral cavity, the nasal passages, and the nasopharynx were involved. Most commonly it appears in the stomach and predominantly in the region of the antrum. We have been able to find a total of 47 cases reported in the available literature. In these cases the lesion was in the stomach in 34, in the nasopharynx in 1, and in the small intestine and colon in 12. To the above we are now adding 2 additional cases.

CASE REPORTS

Case 1.—A 14-year-old male was admitted to the Aretaion Hospital on Dec. 15, 1955, complaining of recurrent attacks of colicky medial abdominal pain of three months' duration. There were short remissions of a few days between the attacks of pain. It occurred in waves lasting for a few minutes and gradually decreasing. It was associated with vomiting, constipation, and distension of the abdomen. The temperature was often as high as 39° C. The attacks lasted for two or three days and usually disappeared after a bowel movement. They had been very frequent during the ten days before his admission to hospital. Except for painless jaundice one year ago there was no previous abdominal illness. There was no significant family history.

ON EXAMINATION.—The abdomen was slightly distended and tender; peristalsis and antiperistalsis were obvious. Palpation was painful, especially in the region of the right iliac fossa, but no mass could be felt. During the examination pain and peristalsis increased, the intestinal coils became more conspicuous, but after some minutes they disappeared and the pain ceased. Our impression was of a partial obstruction in the ileum.

His general condition was good, although he had recently lost some weight. His temperature on admission was 37·5° C. A plain X-ray examination followed by a barium meal revealed an obstruction in the ileum with a large dilatation above the obstructed area. The blood-count was 78 per cent hæmoglobin, 4,100,000 red blood-cells, and 9100 white blood-cells; 73 per cent polymorphonuclear leucocytes, 23 per cent lymphocytes, and 4 per cent eosinophils.

AT OPERATION.—On Dec. 18, under general anæsthesia, a right lower paramedian incision was made. A hard tumour mass, the size of an egg, was found in the proximal ileum. The afferent loop was extremely dilated. Numerous moderately swollen lymph-nodes were present in the mesentery. The tumour with an intestinal segment of about 25 cm. was resected; an end-to-side anastomosis was done on account of the difference in the lumen of the proximal and distal loops.

The post-operative course was uneventful. He was discharged from hospital on Jan. 6, 1956.

PATHOLOGICAL REPORT (Dr. N. Papacharalambous).—Gross examination of the specimen showed that the tumour mass involved the whole thickness of the intestinal wall, protruding symmetrically inside and outside. The tumour was covered by normal mucosa and serosa. It was of a hard consistency and had a reddish-white colour on the cut surface.

Histological examination (*Figs.* 502, 503) showed inflammatory infiltrations consisting of polymorphonuclear leucocytes and plasmocytes. In many areas eosinophils were abundant, together with some cellular

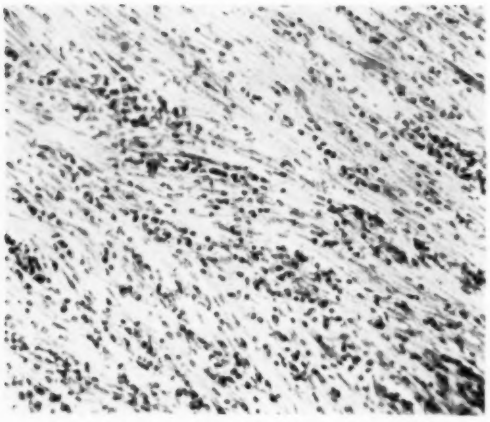

FIG. 502.—Photomicrograph of *Case* 1, showing eosinophilic infiltrations with some cellular elements of connective tissue. (× 80.)

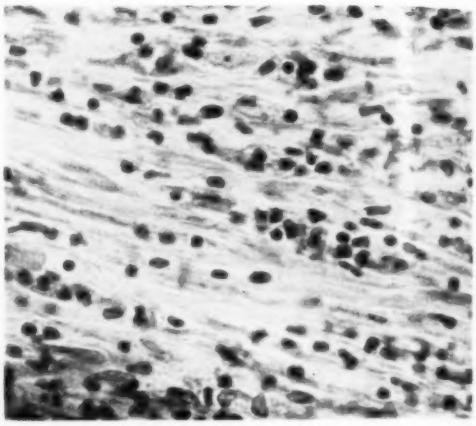

FIG. 503.—*Case* 1. (× 210.)

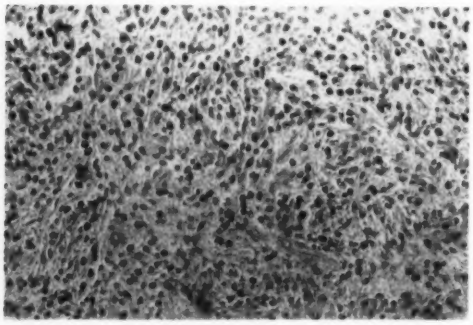

FIG. 504.—Photomicrograph of *Case* 2, showing whorls with numerous eosinophilic leucocytes. (× 80.)

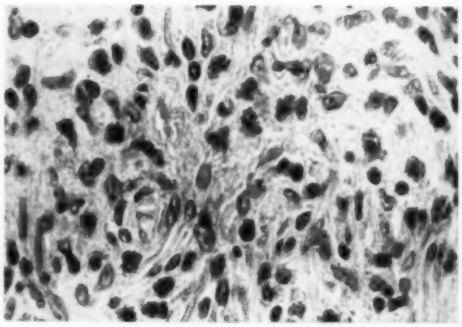

FIG. 505.—*Case* 2. High-power view of infiltrating cells showing the preponderance of eosinophilic leucocytes. Some plasmocytes are visible among the eosinophils. (× 210.)

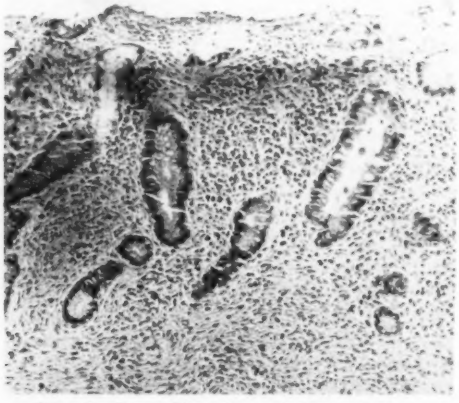

FIG. 506.—*Case* 2. Photomicrograph showing the tumorous tissue infiltrating the interglandular spaces. It is almost reaching to the surface of the mucosa. (× 80.)

elements of connective tissue. The inflammatory infiltrations were either diffused or they formed accumulations separated by immature connective tissue with newly created capillaries. In many places calcification was visible. No malignant cells were seen.

The pathological diagnosis was an inflammatory tumour of the small intestine which we think should be classified as an eosinophilic granuloma of the small intestine.

Case 2.—A 55-year-old woman was admitted to the Aretaion Hospital on April 29, 1957, because of gastric disturbances. She complained that during the last six months she had a feeling of fullness and a burning sensation in the epigastric region, accompanied by nausea and a tendency to vomit. In the last three months these symptoms had increased, especially after eating.

A barium-meal examination revealed an oval, sharply defined filling defect in the bulb of the duodenum, which was interpreted as a polypoid adenoma of the pylorus protruding into the duodenum. The physical examination was negative except for a vague pain in the epigastrium during palpation. The ordinary laboratory examination was also negative. The blood-count was normal. There was no significant medical history and nothing important in the family history.

AT OPERATION.—On May 1, 1957, an operation was performed under general anæsthesia through a high right paramedian incision. A tumour mass in the first part of the duodenum was found, as expected. It was pushed up by slight pressure and passed the pylorus very easily. The stomach was opened along its anterior wall. A polypoid structure 2 2·5 cm. in diameter was attached by a short pedicle to the anterior wall of the pyloric ring. The mucous membrane around the pedicle of the tumour was normal. A polypectomy was done. The gastric wall was sutured in three layers.

The post-operative course was uneventful and the patient was discharged on the tenth post-operative day.

THE SPECIMEN.– The gross examination of the removed lump revealed a soft polypoid mass covered by normal mucosa. The cut surface was pale yellow in colour and included reddish-brown areas. Histological examination (*Figs.* 504–506) showed crowded accumulations of cells of moderate size and also some relatively small cells. The cells were elongated in form, or elliptical or spindle-shaped, and formed diversely arranged bundles. In some areas they formed whorls or showed a palisade-like arrangement of their nuclei. Among the cells numerous vessels were visible with slightly thickened and hyaloid walls and a considerable number of polymorphonuclear eosinophils. Also included were a few lymphocytes, which in some areas formed accumulations resembling small and rudimentary lymph follicles. The muscle-bundles of the mucosal muscularis were disrupted by the above elements, which reached almost to the surface layer of the covering mucosa. No malignant cells were found.

The histological diagnosis was a polypoid eosinophilic granuloma of the pyloric region of the stomach.

REVIEW OF THE LITERATURE

According to Feyrter (1953) the first case of eosinophilic granuloma of the stomach was published by Jaeger in 1932. Feyrter, however, asserts that this condition was known to him since 1928 from autopsies. His cases were reported by Kofler (1952). Kaijser (1937) reported 1 gastric and 2 intestinal cases of eosinophilic granuloma and published a paper on surgical gastro-intestinal allergic affections. Booher and Grant (1951) quote Herrera and Guardia (1948), describing a case in which the pylorus, the duodenum, and the entire small intestine were affected. The same year Barrie and Anderson (1948) reported in England a similar case with granulomatous invasion of the pyloric antrum and infiltration of the duodenum and the proximal 2 ft. of the jejunum. They considered that it was an example of a true organic intestinal reaction on account of an intolerance of the patient to certain foods and a constant blood eosinophilia and a localized tissue eosinophilia of the pylorus. Spencer and Dahlin (1950) published one more case, in which the jejunum was involved as well. Vaneck in 1949 published 6 cases concerning the pyloric region of the stomach, and Stout, who did the pathological study of the above cases, observed 1 more case. Booher and Grant (1951) collected 11 cases, 8 occurring in the stomach alone, 1 in the jejunum, and 2 affecting the antrum of the stomach, the duodenum, and a part of the small intestine. In 1954 Virshup and Mandelberg, after reviewing the cases published by various authors, collected 19 cases in which the stomach and the duodenum were affected and a total of 22 involving the gastro-intestinal tract. Frank (1953), Judd, Civin, and McIlhany (1955), and Tavernari (1955) added 3 more cases involving the stomach. Recently Rigler, Blank, and Hebbel (1956) reported 9 cases, which is the highest number of cases personally recorded ; and Smith (1956) published 2 more cases of gastric granuloma with eosinophilic infiltration.

The small intestine is seldom involved. Kaijser (1937), as already mentioned, published the first 2 cases in this part of the gastro-intestinal tract. Nevertheless, one of these cases was doubtful since neither resection nor biopsy was performed. Polayes and Krieger (1950), in the United States, described the first case of a localized eosinophilic granuloma located in the jejunum. We have found in the available literature 4 more similar cases (Taccani, 1952; Marek, 1954; Unnewehr and Ohrt, 1954; Virshup and Mandelberg, 1954). In 2 of these cases the tumour was located in the jejunum and in 2 in the ileum. Feyrter and his student, Kofler, after performing 3000 autopsies in 1928, found, as already mentioned, 2 cases of eosinophilic granuloma of the intestinal tract, in which one was located in the jejunum and was the size of a cherry seed and the other in the cæcum and the size of a lentil. These cases were reported by Kofler in 1952.

The large intestine is rarely involved.

Apart from the autopsy report of Feyrter, we found 4 more cases described by Fragala (1942), Pezzoli and Reggiani (1952), Pardo and Rodriguez (1952), and de Santis (1954).

DISCUSSION

Eosinophilic granuloma of the gastro-intestinal tract is a clinical entity, characterized by the development of granuloma with eosinophilic infiltration. It appears in two forms, either as a localized tumour or as a diffuse infiltration involving a small or larger segment of the gastro-intestinal tract. The aetiology of this peculiar disease is still unknown.

The diffuse forms occurred in all cases reported by Kaijser (1937). All his patients were syphilitic. In one of them the antral region of the stomach was involved, producing pyloric stenosis. A partial gastrectomy was performed. There was œdema of the wall of the affected bowel. The submucosa was more markedly œdematous, with infiltrations of plasmocytes and eosinophilic leucocytes. The mucosa and the muscular layer were also infiltrated by inflammatory elements and eosinophilic polymorphonuclears. The eosinophils count was 26 per cent on the ninth post-operative day. An allergy to onions existed from childhood, which was considered an aetiological factor. Of the other 2 cases in which the small intestine was involved, only one underwent a resection. The resected part was 190 cm. in length and the microscopical picture was almost similar to the previous case. In the unresected case a segment of the jejunum 50 cm. in length was œdematous and red in colour. This patient had an allergy to salvarsan. An allergy to certain foods, as already mentioned, existed also in Barrie and Anderson's patient (1948), with a white blood-count of 17,000 and 18 per cent eosinophils; in Herrera and Guardia's case no allergy was noticed, and the white-cell blood-count was 16,800 without eosinophilia on admission. The 6 cases published by Vaneck were also free of allergy and so was the patient of Barnett and

Kazmann (1952). Feyrter (1953) found an allergy in all of his operated cases. This author considers eosinophilic granuloma of the stomach to be a result of allergic gastric disturbances which may have long existed. He also thought that these granulomata may develop on pre-existing neurinomata of the gastro-intestinal tract with secondary inflammatory reaction. An allergy could not be found in the history of localized forms of the cases so far published, and there was no allergic history in any of our own cases. However, we believe with Booher and Grant that an allergic background could be an aetiological factor in the diffuse form of this granulomatous disease.

Unnewehr and Ohrt (1954) quote Rowland and Tannhaüser, Goodhill, Shuknecht, and Perlman considering an inflammatory disturbance of the cell metabolism as an aetiological factor, and that eosinophilic granuloma of the gastro-intestinal tract is related to the eosinophilic granuloma of the bones and to the other analogous affections such as the Hand-Shuller-Christian and the Letterer-Shive diseases. However, most authors do not share this opinion, because no case has been reported in which both conditions coexisted. The histological appearances of the lesions in bone are different from those in the gut, as Vaneck (1949) stressed.

Pathology.—Eosinophilic granuloma of the gastro-intestinal tract is characterized by a development of a specific granulomatous tissue which according to Booher and Grant (1951) is composed of:—

1. Fusiform fibroblastic cells with a loose network of collagens and irregularly distributed lymphocytes, which in some areas accumulate to form rudimentary lymph follicles.

2. Eosinophilic polymorphonuclear leucocytes which infiltrate the granulomatous tissue and are most abundant in the deep submucosa and the muscularis. They sometimes break the muscular fascicles in bands, forming cavities of various sizes.

3. An eosinophilic œdematous material which fills the above cavities.

Symptomatology.—The symptoms are those of any benign tumour of the gastro-intestinal tract. In most cases in which the pyloric region of the stomach was involved, symptoms of pyloric stenosis predominated; while in those in which the lesion was located in the small intestine, a chronic or acute intestinal obstruction developed. It should be noted that in some cases there was an increase in the white blood-count and pyrexia, which seems to indicate an inflammatory aetiological factor.

Prognosis.—This is good. In none of the published cases was a recurrence reported after removing the tumour.

Treatment.—In pedunculated tumours polypectomy is the treatment of choice, while in sessile and diffuse forms a resection of the affected area of the gastro-intestinal tract should be performed.

SUMMARY

1. Two unusual cases of eosinophilic granuloma of the gastro-intestinal tract are reported. In the first the tumour was situated about the middle of the small intestine, causing chronic ileus. In the second the tumour was attached by a short pedicle to the anterior wall of the pyloric ring and protruded into the duodenum.

2. Most frequently this condition involves the pyloric region of the stomach (34 cases are reported in the literature); it is rare in the intestine (7 cases in the small and 5 cases in the large intestine).

3. The lesion appears in two forms, either as a real solitary tumour or as a diffuse infiltration, involving a small or larger part of the digestive tube.

4. The cause of the lesion is obscure. Allergic factors or disturbance of the cell metabolism are suspected.

5. In most published cases there was an increase in the white-cell count and pyrexia, which seem to indicate an infection.

6. The prognosis is good, as there was no recurrence in any of the published cases.

7. The pathology, the clinical picture, and the treatment are discussed.

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PRIMARY PLASMOCYTOMA OF THE STOMACH

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EXTRAMEDULLARY plasmocytoma has been reported as occurring in a diversity of organs and tissues, but instances of involvement of the stomach alone are rare. Only 6 such cases have been reported, and to date none in the British literature. The present case is presented to make good that deficiency and also because it has certain features which may be of aetiological significance in so far as plasmocytoma of the stomach is concerned. Because of the paucity of reports of plasmocytoma of the gastro-intestinal tract the literature will also be reviewed.

CASE REPORT

C. H., aged 50 years, a male Jamaican negro, attended the University College Hospital of the West Indies on Nov. 23, 1956. He complained of intermittent epigastric pain of many years' duration which was worse at nights, had no definite relationship to meals, and was relieved by vomiting. Attacks of pain lasted several days and were followed by intervals of freedom lasting up to three months, but for the month prior to attendance at hospital the pain had been continuous and radiated to the back. He had vomited daily, was constipated, and in that month had lost 10 lb. in weight.

FIG. 507.—Section through portion of stomach showing the peptic ulcer and plasmocytoma. (× ⅔.)

ON EXAMINATION.—He was emaciated and listless, with a dry inelastic skin, and was obviously anæmic. There was upper abdominal distension, visible peristalsis from left to right, and marked succussion. Clinical examination revealed no other abnormalities. His blood-pressure was 90/50 mm. Hg.

Investigations.—Hæmoglobin 6·9 g. per cent; white-cell count 5500 per cu. mm. with a normal differential; urine analysis normal; serum electrolytes normal. Radiography of the chest revealed some emphysema and pleural thickening at both costophrenic angles. An opaque meal showed a dilated stomach with hyperactive peristalsis, normal mobility, and retarded emptying rate. The pylorus was greatly narrowed. The duodenal cap was never fully visualized because of the small quantity of barium reaching it, but there appeared to be marked coarsening of the mucosa suggesting that stenosis was due to the scarring of chronic peptic ulceration.

He was admitted to hospital on Nov. 30. After transfusion of three pints of whole blood and daily gastric saline lavage, operation was performed on Dec. 4 under general anæsthesia.

AT OPERATION.—Inspection of the stomach revealed a large, hard, irregular mass in the pylorus with several enlarged, supra- and subpyloric lymph-nodes. Smaller nodes were palpable along the lesser curve, but the other intra-abdominal lymph-nodes were not enlarged. The spleen was moderately enlarged to about twice the normal size, but was normal in consistency. The liver appeared to be normal. There were no peritoneal metastases. A diagnosis of gastric carcinoma was made and a high radical gastric resection by the Billroth I method was performed. Approximately three-quarters of the stomach, the first part of the duodenum, and the greater and lesser omenta were removed. The tumour was adherent to the pancreas and was dissected from it.

FIG. 508.—Infiltration of the ulcer margin with myeloma cells. H. and E. (× 72.)

PROGRESS.—The patient regained consciousness three hours after operation but his blood-pressure was 90/50 mm. Hg and pulse-rate 112/min. During the first four days his condition was reasonably satisfactory, but he required repeated blood transfusions to a total of five pints to maintain his blood-pressure at the normal level. On the fifth day his condition suddenly deteriorated and blood-stained fluid exuded from the wound. His blood-pressure fell to 60/20 mm. Hg and the pulse-rate rose to 120 per minute. A rapid blood transfusion of two pints produced temporary improvement, but thereafter he lapsed into coma and died on the sixth post-operative day.

PATHOLOGY.—The operation specimen was a sleeve of stomach measuring 35 cm. along the greater curvature and 14 cm. along the lesser, with the greater and lesser omenta attached. Around the pylorus there were several enlarged, hard lymph-nodes with a few smaller indurated nodes along the lesser curve. Projecting from the posterior aspect of the pylorus was a smooth, spherical tumour measuring 2·5 cm. in its greatest diameter. The wall of the stomach in this area felt thickened and indurated. The stomach was opened along the greater curvature, revealing

a large, deep ulcer crater 1·5 cm. in diameter in the posterior wall of the pylorus. The edge of the ulcer was sharp, well-defined, and showed no heaping up or eversion, but the surrounding mucosa was œdematous and hyperplastic and the stomach wall greatly thickened. On section the cut surface of the ulcer and tumour had a uniform and somewhat translucent greyish-white appearance with distortion and blurring of the normal architecture of the stomach wall (*Fig.* 507). A diagnosis of carcinomatous change in a chronic peptic ulcer with lymph-node metastases was made.

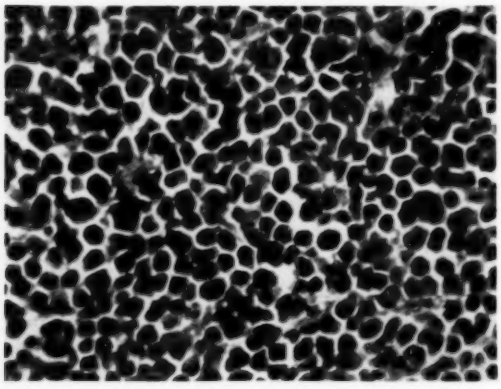

FIG. 509.—High-power view of a typical area of the plasmocytoma. H. and E. (× 360.)

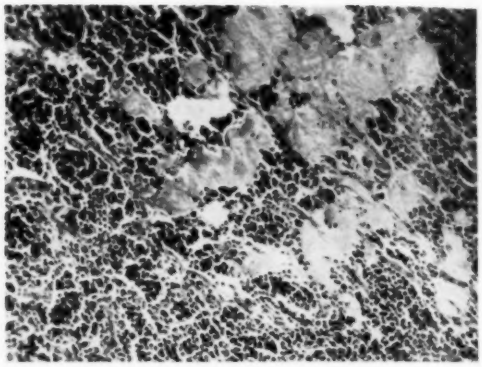

FIG. 510.—Lymph-node infiltrated by myeloma cells and showing 'para-amyloid' deposition. H. and E. (× 72.)

On microscopy the ulcer showed the typical picture of an active chronic peptic ulcer with a fibrino-purulent exudate on the surface, cellular granulation tissue underlying this, and hyalinized scar tissue replacing the muscle coat at the base with endarteritis of many of the vessels. At one margin the mucosa was infiltrated with acute and chronic inflammatory cells, but was otherwise not remarkable. The opposite margin (*Fig.* 508), however, contained a dense infiltrate, principally of plasma cells, many of which were very atypical in appearance. Immature and giant forms, occasional multinucleate cells, and mitoses were seen, yet all were clearly recognizable as plasma or myeloma cells with the typical basophilic cytoplasm, usually eccentric nucleus, and the 'cart-wheel' arrangement of the nuclear chromatin. Scattered throughout the scar tissue at the base of the ulcer were foci, many of them large, of similar atypical plasma cells. The tumour adherent to the serosa, most likely a lymph-node but unrecognizable as such, was composed entirely of sheets of atypical plasma cells with a scanty stroma (*Fig.* 509). The separate lymph-nodes examined all showed varying degrees of infiltration with the same cells and, in one, a small area of 'para-amyloid' deposition was noted (*Fig.* 510).

A diagnosis of malignant plasmocytoma of the stomach with lymph-node metastases was made.

Unfortunately the patient died before further investigations could be undertaken and consent for autopsy was adamantly refused.

DISCUSSION

The first point to be considered is whether the present case is one of solitary plasmocytoma of the stomach. Snapper, Turner, and Moscovitz (1953) advise caution in diagnosing any extramedullary plasmocytoma as being solitary unless the most careful investigations by radiology, bone-marrow aspiration, serum-protein estimations, including electrophoresis, and urine analysis are performed and a long follow-up is undertaken to exclude the possibility of extramedullary lesions complicating latent multiple myeloma. This case report may therefore be adversely criticized in failing to meet such criteria as the diagnosis was made post-operatively and the patient died before the necessary investigations could be done. None the less there was nothing to suggest a diagnosis of multiple myeloma from the clinical history or from such investigations as were done. At operation no evidence of tumour was noted in any other organ despite careful search. The radiographs of the chest and abdomen showed no bony lesion in those parts of the skeleton which, with the possible exception of the skull, are the earliest sites to be affected in multiple myeloma.

The strongest evidence in favour of accepting a diagnosis of solitary plasmocytoma, despite an admittedly incomplete investigation, is an analysis of the literature on multiple myeloma and extramedullary plasmocytoma. No case of multiple myeloma with plasmocytoma of the stomach as the only extramedullary lesion has yet been reported. Conversely none of the 6 cases of solitary plasmocytoma of the stomach reported showed any evidence of multiple myeloma. Involvement of the gastrointestinal tract in multiple myeloma is rare in itself and such cases as have been reported showed several myelomatous deposits in the small and large gut, but rarely in the stomach and never in the œsophagus. When the evidence for and against is carefully considered there seems every reason to accept the present case as a bona fide example of a solitary, malignant plasmocytoma of the stomach.

Aetiology.—It is beyond the scope of this article to discuss the aetiology of multiple myeloma and plasmocytoma in general, but it would not be out of place to postulate a possible aetiological factor in this case and perhaps in others. In reading the literature on plasmocytoma of the stomach one is impressed by the length of the history given in many of the cases. All previous authors have assumed that the tumour has arisen *ab initio* in the stomach and has either existed in a benign form for many years and then become malignant, or has been of

low-grade malignancy from the start, or has been completely benign throughout its course. The clinical history, operation findings, and histological picture all clearly indicate that this patient had suffered from a chronic peptic ulcer for many years and had recently developed symptoms and signs of malignant change in a gastric ulcer. There is good reason to believe that the malignant change in this case was to that of malignant plasmocytoma.

The first plasmocytoma of the gastro-intestinal tract was described by North (1924). Twenty-four further cases have been reported (*Tables I, II*) and the present case brings the total to 26. Only 9 cases of plasmocytoma of the stomach are on record. In 6 of these there was a solitary lesion in the stomach, while in the other 3 there were lesions in other parts of the gastro-intestinal tract suggesting a multicentric origin. The present case is therefore the seventh case of plasmocytoma of the stomach. Schumann (1953) refers to 3 cases operated on by Pelagatti in 1941, but we have not been able to trace the case reports. Hefferman (1947) reported the only case of plasmocytoma involving the duodenum and pancreas, but autopsy revealed tumour deposits in the ribs and it is significant that Bence-Jones proteinuria was found ante mortem, a feature said to be absent in cases of extramedullary plasmocytoma (Snapper and others, 1953); so far the only part of the gastro-intestinal tract apparently immune from this tumour is the œsophagus.

Table I.—SOLITARY PLASMOCYTOMA OF STOMACH

AUTHORS	SEX	AGE	RACE	LENGTH OF HISTORY	X-RAY DIAGNOSIS	LYMPH-NODES	TREATMENT	RESULT
Couret (1946)	F.	48	White	8 yr.	Pyloric carcinoma	+	Gastric resection	Died of recurrence 1 yr. post-operatively
Schwander and others (1947)	M.	42	Coloured	7 yr.	Pyloric stenosis with D.U.	+	Gastric resection	Died from pulmonary embolism on 15th day
Ende, Daron, Richardson, Raider, and Ziskind (1950)	M.	63	Coloured	3 yr.	Carcinoma stomach	+	Gastric resection	Well 7 mth. later
Schumann (1953)	M.	53	White	3 mth.	Carcinoma stomach	–	Gastric resection	Died of recurrence after 5 mth.
Ruland (1954)	F.	47	White	?	Carcinoma stomach	+	Gastric resection and radiotherapy	Died of metastases after 2 yr.
Merritt (1955)	M.	53	White	Many yr.	Carcinoma stomach	+	Gastric resection	Died of recurrence 1 yr.
Annamunthodo and Robertson (1959)	M.	50	Coloured	Many yr.	Pyloric stenosis with D.U.	+	Gastric resection	Died 6th day post-operatively

The gastric mucosa normally contains plasma cells and these are increased in the presence of inflammation. It seems reasonable that on rare occasions malignant change could occur in these cells. It can of course be argued that chronic peptic ulcer is a relatively common condition and that the two diseases may coexist, but the obvious very intimate association observed between the two in this case suggests that they are related and it is also obvious that the ulcer preceded the plasmocytoma. The cases of Schwander, Estes, and Cooper (1947) and Merritt (1955) were similar to our case in that both patients had long histories of dyspepsia and were found at operation to have peptic ulcers and plasmocytomas of the stomach. In other reported cases the length of history and operation findings are suggestive, but it is not clear whether a chronic ulcer was found.

Review of the Literature.—Kahler (1889) is generally credited with the first full description of multiple myeloma, although Arnold (1873) had reported the first case with extramedullary deposits. By 1943 only 127 cases of extramedullary plasmocytoma were reported (Hellwig, 1943), but the number had risen to 190 by 1957 (Hampton and Gandy, 1957) and this list is probably incomplete. Nevertheless it is evident that the tumour is relatively rare. Although almost every organ and tissue is liable to be affected, the commonest site is the upper respiratory tract, the nasopharynx and tonsils accounting for 50 per cent of these tumours (Ingegno, 1954), yet plasmocytoma constitutes only 0·5 per cent of all malignant tumours of the respiratory tract (Jaeger, 1942). The next common site is the conjunctiva, but Ingegno (1954) suggests that many of these lesions may be plasma-cell infiltrations associated with chronic inflammations such as trachoma.

As with multiple myeloma, the highest incidence occurs in the middle and later decades, but 2 cases have been reported in children aged 8 and 15 years respectively, interestingly enough both Turks (Arel, 1946). The age incidence of the gastric cases approximates to that of gastric carcinoma.

Typically the gastric cases had either a long history suggestive of chronic peptic ulcer culminating in pyloric obstruction or a short history of weight loss, anorexia, and vomiting leading to a clinical diagnosis of gastric carcinoma. In tumours of other parts of the gastro-intestinal tract obstruction and abdominal pain have been the dominant features. Intestinal hæmorrhage has been frequent.

Radiologically the lesions in the gastro-intestinal tract have been seen as strictures or filling defects, while in the gastric cases the diagnosis of gastric neoplasm or pyloric stenosis due to peptic ulceration has been made, corresponding in each case to the clinical impression. It is unlikely that a diagnosis of

plasmocytoma will be made clinically or radiologically.

In all the gastric cases the diagnosis of carcinoma was made at operation and every case was treated primarily by radical gastric resection. The results have been poor. Two patients, including the present case, died within fifteen days of operation; 4 died of recurrence or metastases within two years; 1 patient was followed up for only seven months. The results of treatment of plasmocytoma in other parts of the gastro-intestinal tract have been somewhat better, with 3 survivals of over eight years. The

Table II.—Other Plasmocytomas of Gastro-intestinal Tract

Authors	Sex	Age	Race	Length of History	Primary Sites					Lymph-nodes	Treatment	Result
					Stomach	Duo-denum	Jejunum	Ileum	Cæcum/ Colon	Rectum			
North (1924)	F.	47	White	3 mth.							—	Resection	Died 36 hr.
Moreau and von Bogaert (1925)	F.	39	White	?			+				+	Resection	Died 4th day
Vasiliu and Popa (1928)	F.	32	White	5 yr.	+			+	+		+	Nil	Died
Razzaboni (1930)	?	?	?	?				+	+		?	Resection	?
Vallone (1930)	M.	24	White	4 mth.				+			—	Resection	Well after 3 yr.
Brown and Liber (1939)	M.	57	Coloured	10–14 yr.				+	+	+	+	Nil	Died
Jaeger (1942)	F.	45	White	?					+		+	Resection	Recurrence (treated by radiotherapy)
Esposito and Stout (1945)	M.	35	White	5 yr.			+				+	Resection	Recurrence 2 yr.
Hinkel (1945)	?	?	?	?				+			?	?	?
Arel (1946): (1)	M.	8	Turk	6 mth.				+			—	Resection	Died 2nd day
(2)	M.	15	Turk	?					+		+	Resection	Recurrence 3 mth.
Bastrup-Modsen (1947)	M.	49	White	?			+				+	Resection	Died from recurrence 1 yr.
Hefferman (1947)	M.	53	White	3 mth.		+					?	Palliative surgery	Died 24 hr.
Sarasin (1950)	F.	45	White	?					+			Resection and radiotherapy	Died 12 yr.
Moutte, Laffargue, and Eisenbeth (1951)	M.	33	White	Incidental finding				+			+	Resection	No follow-up
Gupta (1953)	M.	35	Hindu	6 mth.					+		+	Resection	Well after 6 mth.
Ingegno (1954)	F.	51	White	Sudden onset			+				+	Resection	Well after 2 yr.
Merritt (1955)	F.	34	Coloured	8 yr.	+						+	Resection	Well after 8½ yr.
Hampton and Gandy (1957)	F.	41	White	3 mth.	+					+	+	Radiotherapy and resection	Well after 8 yr.

prognosis for extramedullary plasmocytoma of sites other than the gastro-intestinal tract is even better (Dolin and Dewar, 1956). A remarkable feature for which no explanation can be offered is the high immediate post-operative mortality in gastro-intestinal cases.

Plasmocytomas are radio-sensitive. In Hampton and Gandy's (1957) case the tumour disappeared following irradiation and nitrogen mustard treatment, but recurred two years later. Probably all cases should be subjected to prophylactic post-operative irradiation, but this form of treatment did not prevent a fatal outcome in Ruland's (1954) case.

Pathology.—Dolin and Dewar (1956) classify tumours of plasma cells into: (1) Multiple myeloma, (2) Solitary myeloma of bone, (3) Plasma-cell leukæmia, and (4) Extramedullary plasmocytoma; but most authors would not separate plasma-cell leukæmia from multiple myeloma (Snapper and others, 1953).

Extramedullary plasmocytoma does not exhibit the disturbances in protein metabolism seen in multiple myeloma (Dolin and Dewar, 1956), although 1 of Merritt's cases did show a reversal of the serum albumin/globulin ratio. Merritt (1955) states that hyperglobulinæmia does not necessarily indicate bony metastases. Gupta (1953) and Hefferman (1947) reported Bence-Jones proteinuria in their cases, but in the latter involvement of bone was found at post-mortem examination.

The diagnosis is usually made histologically from biopsy or operation specimens. The typical picture is generally unmistakable, but it may be difficult to decide whether a particular tumour is truly neoplastic or merely inflammatory and whether it is benign or malignant. The duration of the tumour is of no help, as some are apparently of low-grade malignancy *ab initio* while others behave in an entirely benign manner throughout their course. As with other forms of neoplasia malignancy may supervene, in some cases in a fulminating manner, in a tumour which originally seemed benign. Histologically, although a certain cellular variation may be encountered, there is a definite characteristic picture best described in Snapper's words: ". . . it is common to find a monotonous uniformity in the staining qualities, texture and size of the myeloma cells".

Involvement of the regional lymph-nodes has been the rule in plasmocytoma of the gastro-intestinal tract, and this in itself should be accepted as evidence of malignancy, though it does not necessarily indicate its degree or imply a bad prognosis (Dolin and Dewar, 1956).

Where more extensive metastases occur, especially in bone, and in cases which have multicentric foci, the possibility of latent multiple myeloma must be considered. None the less Ingegno (1954) could find no report of the development of multiple myeloma in cases of gastro-intestinal plasmocytoma. Hampton and Gandy (1957), in a later review, considered that only 2 such cases showed evidence of multiple myeloma. Snapper and others (1953) state that the complete picture of multiple myeloma may emerge from cases originally diagnosed as extramedullary plasmocytoma, but do not relate this specifically to lesions of the gastro-intestinal tract. It is pertinent to note that Hayes, Bennet, and Heck (1952) found only 1 instance of involvement of the gastro-intestinal tract in a study of 38 cases of extramedullary lesions in multiple myeloma, although 27 of the cases showed lesions elsewhere, principally in spleen, lymph-nodes, and liver. Furthermore, in all cases of plasmocytoma of the gastro-intestinal tract where investigations have been done to exclude multiple myeloma there has been no evidence of this disease.

It may be concluded that extramedullary plasmocytoma of the gastro-intestinal tract is a definite clinical and pathological entity.

SUMMARY

The seventh case of solitary plasmocytoma of the stomach is reported.

It is suggested that in this case and possibly in others the tumour arose as a rare type of malignant change in a chronic peptic ulcer.

The literature on extramedullary plasmocytoma of the gastro-intestinal tract is reviewed.

Our thanks are due to Mr. L. Edwards, of the Department of Pathology, for his assistance with the photography.

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ACUTE DILATATION OF THE STOMACH FOLLOWING THORACIC INJURY

REPORT OF TWO CASES WITH DISCUSSION

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ACUTE dilatation of the stomach has been recognized for not far short of a century. It is most often a post-operative complication. Doolin (1918) found that of 188 collected cases 133 were post-operative.

There is a general impression that its post-operative incidence is declining. This may in part be due, as Starr (1953) has suggested, to its being confused with other conditions such as ileus and gastric retention; but on the other hand there may be a true reduction in incidence due to the common use of gastric aspiration during and after major abdominal surgery. Aspiration of gas alone may in some cases not be recognized as early acute dilatation. Whatever the explanation, cases of acute dilatation occurring other than following abdominal operations assume greater importance in view of their relatively increased frequency.

FIG. 511.—*Case* 1.

FIG. 512.—*Case* 2.

CASE REPORTS

Case 1.—B. F., a boy aged 9 years, was admitted soon after having fallen on to the spike of a park railing. The spike had wounded the front of the lower left chest wall. He looked shocked, though the extremities were warm. He complained of pain on breathing and of thirst. There was a laceration ½ in. long over the eighth rib in the left anterior axillary line, with surrounding surgical emphysema. There were no abnormal abdominal findings. Radiographs of the chest and abdomen were normal.

An hour later he became more distressed and a little cyanosed. There was no significant change in the pulse-rate or blood-pressure, but his condition gave some cause for anxiety, and seemed out of keeping with the apparently trivial injury. He complained of pain in the chest and in the left upper abdomen. His breathing was more embarrassed, shallow, and grunting, with a pause in inspiration. He was observed to 'swallow' air on one occasion.

The abdomen was now distended and there was tenderness in the left hypochondrium. It was resonant in the midline and relatively dull in the flanks. The possibility of some intra-abdominal injury, perhaps to the spleen, was entertained. Further radiographs two hours after admission showed no lesion in the chest, but the stomach was greatly distended with gas (*Fig.* 511). A tube was passed and a large quantity of gas was aspirated. There was a little pinkish fluid present: that the coloration was due to sweet pigment and not blood was confirmed on microscopy. The stomach was readily emptied. His distress was dramatically relieved and his colour improved. The abdomen was now soft and free from tenderness.

The wound was excised with local analgesia. The track passed upwards and had not penetrated the chest wall. His subsequent course was uneventful. Gastric aspiration was continued for twenty hours—but little was

withdrawn. Fluids and electrolytes were administered intravenously during this time.

Case 2.—R. P., a boy aged 8 years, was admitted as an emergency one and a half hours after falling from a railing on to a spike, which had wounded the left chest wall over the seventh rib in the anterior axillary line. The patient was in considerable pain and the respirations were grunting. The pulse was thin, thready, and rapid. It was difficult to correlate the clinical features with the nature of the injury. An intra-abdominal hæmorrhage from the spleen was considered.

Radiographs of abdomen and chest were performed. The chest film revealed a fracture of the seventh rib but no hæmo- or pneumo-thorax. The abdominal film (within 2 hrs. of injury) revealed gastric dilatation (*Fig.* 512).

Gastric aspiration was instituted and a considerable amount of gas withdrawn, together with about 3 oz. of gastric juice and partly digested food. Toilet of the chest wound was carried out under general anæsthesia. The intercostal space had been penetrated. There were 2 oz. of blood in the pleural cavity and a small subpleural hæmatoma, but no significant lung lesion. Convalescence was uneventful. Gastric aspiration and intravenous fluid and electrolyte replacement were discontinued after twenty-four hours.

DISCUSSION

These two cases show several similarities. Firstly, both had sustained injuries of similar cause and site and had early admission to hospital. In both patients the general condition gave cause for alarm and seemed out of proportion to the severity of the injury. In both there was radiographic evidence of gross gastric dilatation by gas. In one this was present within one and a half hours of injury, and in the other the condition developed between serial radiographs performed at an interval of two hours. In neither case was there more than a few ounces of fluid in the stomach. Abdominal findings consistent with early hæmorrhage from a damaged viscus were, together with general features of distress, quickly dispelled following decompression of the stomach. In both patients rapid recovery followed.

Brinton (1859) has been credited with first suggesting a neurogenic cause of acute dilatation of the stomach. Either inhibition of the vagus or sympathetic overactivity could in theory lead to loss of gastric tone. The rapidity with which dilatation may become established and the diversity and indirect relationships of incidents which have led to its onset are strongly in favour of a neurogenic factor as a primary cause of the atony which allows distension to take place. This is further supported by an observation of Lambert Rogers (1935), who has noted the condition in a young woman a few hours following removal of a cervical neurinoma by laminectomy. Rapid recovery of the early case following gastric aspiration indicates that the neurogenic factor is mostly short-lived and suggests that some other agent or agents are concerned in the persistence of the established condition.

In most cases gaseous distension is a marked factor and may exist in the absence of any great fluid accumulation in the early case. Gas is without doubt derived from 'air swallowing'—this is an act at which not all individuals are equally adept. In recorded cases of dilatation, as well as in one of our own, air swallowing has been observed. It would seem that it is a combination of a loss of gastric tone with the ability and tendency to swallow air that leads to acute gastric dilatation. This would explain the observation of some writers that an individual predisposition seems to exist in some patients who have presented with the complication following successive operations.

In a few particular cases the dilatation has followed directly from ingestion of a comparatively large amount of food and drink, especially after a period of starvation. Markowski (1947) reported 4 cases occurring in prisoners of war during 1939–1945. In such cases gaseous distension may play no significant part.

On the basis of the inconstant finding at autopsy of gross dilatation of the stomach and duodenum as far as the crossing of the mesentery and superior mesenteric vessels, the theory of origin due to obstruction at this site—first proposed by Rokitansky (1863)—has at times been held. We cannot accept this theory as of primary importance in view of the rapidity of dilatation (as in the cases here described) and in view of the absence of any similar syndrome in cases of duodenal obstruction from other causes observed in surgical practice. It is, however, not possible to dismiss this mechanism as a propagating factor in advanced cases. No other known factor, functional, anatomical, or neurogenic, could adequately explain the observed site of the termination of the dilatation.

Alterations in electrolyte balance have been implicated in upper and lower gastro-intestinal 'ileus'. Starr (1953) found that acute post-operative dilatation was largely an event of the second day, a time when major electrolyte disturbances may have become manifest. In acute dilatation arising rapidly, as in the cases we have recorded, it would seem difficult to conceive that any electrolyte disturbance sufficient to be of primary importance could have developed. There is, however, no doubt as to the importance of fluid and electrolyte loss in acute dilatation once the condition has become established, when it is the major pathogenic factor.

It is very doubtful whether fluid accumulation is the result of increased gastric secretion. Failure of absorption of normal salivary, gastric, and duodenal secretions, including bile and pancreatic juices, adequately accounts for the volumes of fluid involved. The findings in our cases of only a few ounces of fluid is evidence that fluid accumulation is not a vital factor in the early stages of acute dilatation.

Diagnosis.—It is most important that there should be a general awareness of the possibility of acute dilatation as a complication of any injury or operative procedure. Where the general condition of the patient is not wholly and adequately attributable to other lesions the presence of acute dilatation must be excluded. There may be very little to draw attention to the abdominal viscera. Nausea and vomiting are not a feature. Vomiting should scarcely be expected in a condition resulting from gastric atony. Fluid regurgitation is seen only in late cases, and is an effortless overflowing of the grossly distended viscus. The abdomen becomes distended and in the lean subject this sign should be evident early. The central abdomen becomes resonant—but

it is easy to misinterpret this and to focus attention on the relative dullness of the flanks. In an early case with little fluid accumulation it may not be possible to elicit a succussion splash. On the whole, the abdominal findings in the early case set too severe a test upon one's acumen to do more than allow the possibility of acute gastric dilatation.

Confirmation of the diagnosis depends upon two procedures:—

1. '*Sounding the Stomach*'.—Hamilton Bailey (1939), in coining this term, emphasized that no possible harm could accrue from the passing of a gastric aspiration tube, and declared that it was the "antithesis of good judgement" to display "misdirected compassion" by withholding the passage of a tube to avoid distressing the patient.

We should like to support this view very strongly. Some of these patients seem to be unusually resentful of gastric intubation. If lack of co-operation prevents the successful use of tubes of normal calibre, then with no hesitation a wide-bore stomach tube should be employed. We recall the case of a young woman in whom something was amiss following cholecystectomy, where this determination to intubate the stomach was necessary, diagnostic, and no doubt life-saving.

2. *Radiography*.—Gaseous accumulation is readily revealed by radiography, which is obviously of the greatest value in early cases. It is possible that, especially in the hands of the nursing staff, aspiration from the stomach of gas alone (in those cases where no fluid accumulation has yet occurred) may not be interpreted as gastric dilatation—though it may be of lasting therapeutic value. Therefore where immediate radiography is intended, it may be wise to delay aspiration till the initial films have been taken.

Treatment.—The stomach is emptied and kept empty. In early cases there may be a rapid return of normal tone. When little is being aspirated, and no significant accumulation takes place over periods of several hours, the indwelling tube may be withdrawn. Control of water, salt, and potassium balance are instituted as soon as the diagnosis is made, and constitute the most important factor in reducing the mortality of the disorder. In the past impressive figures have been produced showing the value of posture in treatment—namely, the use of the prone position with Trendelenburg tilt. The only recognizable rationale is based upon duodenal obstruction as a vital aetiological agent, and since this is not accepted, our view must be that posture is relatively unimportant.

SUMMARY

Two cases of acute gastric dilatation following minor thoracic injury are reported. The aetiology and diagnosis of acute dilatation are discussed.

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CUSHING'S SYNDROME ASSOCIATED WITH CARCINOMA OF THE BRONCHUS

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IN 1952 Thorne reported 2 cases of carcinoma of the bronchus associated with Cushing's syndrome. Both were characterized by a short rapid course, wide dissemination, and early death. At that time he was able to find a total of 11 cases of intrathoracic neoplasm associated with a Cushingoid syndrome; the majority of them, however, in association with a primary tumour of the thymus. The association of Cushing's syndrome with primary bronchial carcinoma has now been reported in 6 cases: Brown (1928); Thorne (1952)—2 cases; Spaulding, Oille, and Gornall (1955); Metzler and Flink (1956); Harrison, Montgomery, Ramsey, Robertson, and Welbourn (1957). In most of these instances the bronchial carcinoma was of the oat-cell type, its progress was rapid, and death occurred at an early stage.

All of these cases have shown various peculiar features too numerous to mention. The case to be reported here was characterized by a typical Cushing's syndrome, very slow progress of the bronchial carcinoma, temporary response of the Cushing's syndrome to subtotal adrenalectomy, and a bizarre primary acquired hæmolytic anæmia.

CASE REPORT

A woman, aged 42 years, complained in December, 1955, of marked ulceration of both legs and of anæmia for two years. In addition she had gained at least a stone in weight during this period, and had noticed her face becoming red and congested. For twelve months her menses had ceased, and she had noticed considerable hirsutes of the chin and upper lip. More recently she had developed œdema of both legs, considerable dyspnœa on exertion, and marked emotional lability.

She was obese, the typical moon-face was apparent, her complexion was florid, and she was distinctly hirsute (*Fig.* 513). Marked purple striæ were present on the abdomen, many petechial hæmorrhages were seen over the body, she had well-developed koilonychia, the typical buffalo-hump of Cushing's syndrome, and large deep sloughing ulcers on the posterolateral surfaces of both legs.

In addition both the liver and spleen were considerably enlarged and palpable.

Hb, 37 per cent (5·5 g.). R.B.C. 3,500,000. C.I., 0·5. P.C.V., 31 per cent. Serum-sodium, 167 m.eq. Serum-potassium, 3.85 m.eq. Serum-chlorine, 93 m.eq. W.R., negative.

She clearly had a Cushing's syndrome and an unexplained hæmolytic anæmia, the latter previously having been investigated, but no satisfactory diagnosis reached. At the time of admission she was jaundiced, there was no bile in the urine, the Van den Bergh reaction

FIG. 513.—Cushing's syndrome before adrenalectomy, showing the typical obesity, 'moon-face', purple striæ, and petechial hæmorrhages.

was indirectly positive, and these features could be taken to account for the splenic, if not the hepatic, enlargement. There was no excessive red-cell fragility, Coomb's test was negative, and the urinary urobilin was increased. In addition the Dorath-Landsteiner test (for cold hæmolysis) was negative, and the cold agglutinins titre was 1 in 12. The anæmia improved with treatment.

In addition to the features described, the diagnosis of Cushing's syndrome was based on the following evidence.

Fasting blood-sugar, 194 mg. per cent; blood-pressure, 160/100.
½ hour after glucose, 260 mg. per cent.
1 hour after glucose, 324 mg. per cent; urine, orange.
1½ hours after glucose, 335 mg. per cent; urine, orange.
2 hours after glucose, 307 mg. per cent; urine, orange.
Urinary 17-ketosteroids, 8·5 mg./24 hr.
Urinary 17-ketogenic steroids, 18 mg./24 hr. (normal female 4·6–13·4 mg.).
Urinary corticosteroids, 6·5 mg./24 hr. (normal, 2–6 mg.).
Urinary sodium, 0·075 g./24 hr.
Urinary potassium, 2·9 g./24 hr.

Radiography of the skeleton revealed generalized osteoporosis, and multiple fractures (? Looser's zones)—left pubic rami, upper shaft right femur, right 4th, 9th, and 10th, and left 5th, 6th, and 7th ribs. In addition a radiograph of the chest revealed a large mediastinal mass, and an intravenous pyelogram showed the form and function of the kidneys to be normal.

Jan. 1, 1956: Left total adrenalectomy—weight 9 g.—the cortex appearing hypertrophic.

Jan. 16: Right subtotal adrenalectomy—weight removed 5 g.

Progress.—The blood-pressure fell to 135/80 and remained at about that level until October, 1956. In addition the hirsutes disappeared, the face became less florid, and normal menstruation commenced in May, 1956. Curiously enough the very large and very deep leg ulcers healed rapidly after adrenalectomy, the jaundice subsided, and the anæmia improved:—Jan. 23, Hb, 64 per cent; Feb. 28, Hb, 70 per cent; May 28, Hb, 86 per cent. Also, the nails became normal.

Unfortunately, on Oct. 21 the patient sustained a minor injury to her leg, developed a large hæmatoma which elevated the skin from the ankle to the knee, and the skin sloughed. She was readmitted to hospital, and it was noted that the Cushing's syndrome had recurred, the menses had just ceased, the hirsutes was recurring, and the face was now florid and cyanosed. B.P. 200/120. The large skin defect was grafted. A chest radiograph showed that the mediastinal mass was increasing in size. The lung fields still appeared normal. The healing of the grafted area was slow. On Dec. 4 a bronchoscopy was carried out and a fixed, inoperable carcinoma of the right upper-lobe bronchus was found. A biopsy was taken, and a carcinoma simplex (or poorly differentiated adenocarcinoma) was diagnosed.

During the year 1957 the patient was admitted to hospital on several occasions for rest in bed to promote healing of the ulcerated leg, but it never healed properly and later the other leg broke down. In other respects she remained well, although always dyspnœic and cyanosed, and the Cushing's syndrome became more and more marked. Repeated radiographs of the chest revealed an increase in the mediastinal shadow, and finally some collapse of the right upper lobe. She remained, however, well and cheerful, but died suddenly at home in January, 1958, following an attack of dyspnœa.

DIAGNOSIS.—Although the diagnosis of Cushing's syndrome was originally entertained, the hilar mass, the enlarged liver, and the enlarged spleen were disturbing features. The association of slight jaundice without bile-pigment or salts in the urine, splenic and hepatic enlargement, and the curious painless leg ulcers suggested a concomitant hæmolytic anæmia. Neither abnormal hæmolysin nor abnormal red-cell fragility has, however, been detected.

The mediastinal glandular enlargement did not appear to be associated with pulmonary or bronchial changes, and the diagnosis of bronchial carcinoma, though considered, was not pursued at the outset. It was believed that the Cushing's syndrome was due to a carcinoma of the adrenal cortex, associated with secondary deposits in the liver and in the mediastinal glands. Operation was undertaken with a view to exploring the adrenals and subtotally resecting them should they prove to be hyperplastic.

The clinical features and laboratory evidence upon which the diagnosis of Cushing's syndrome was made has been briefly related. It is not always easy to be sure whether a fat, florid, rather hirsute woman with mild diabetes and slight hypertension is suffering from this condition or not. In the patient described here the diagnosis was based on the appearance—florid moon-face, hirsutes, obesity of the trunk, striæ on the lower abdomen, and capillary fragility associated with ecchymosis. Investigation showed diabetes, hypertension, amenorrhœa for more than a year, osteoporosis and multiple fractures, a marked sodium and water retention, and a very high excretion of potassium in the urine. The daily excretion of 17-ketosteroids was within normal limits, but the urinary 17-ketogenic steroids and urinary corticosteroids

were increased. It would seem, therefore, that the diagnosis was established beyond doubt.

Bilateral adrenalectomy was attempted by the transabdominal approach. The left adrenal was easily resected in spite of the splenic enlargement. It weighed 9 g., and the cortex appeared moderately hyperplastic. The right lobe of the liver was, however, enlarged to about twice its normal size, and although the surface seemed normal, the appearance suggested that a very large mass was occupying the centre of the lobe. For this reason, it proved impossible to visualize the right adrenal gland. Accordingly, this gland had to be removed at a second operation 15 days later by a posterolateral approach, excising the 12th rib. All but a small corner of this gland was resected, this remaining eighth having an adequate blood-supply. The portion of the right adrenal removed weighed 5 g., and the cortex appeared normal. The combined weight of adrenal tissue removed amounted therefore to 14 g., which is about 2 g. more than the normal combined weight of fresh gland.

After operation, most of the symptoms and signs of Cushing's syndrome disappeared, the leg ulcers healed spontaneously, and the anæmia improved with oral iron. In addition, normal menstruation recurred. Eight months later, however, it was noted that the symptoms had recurred, that the hypertension was more marked, and that dyspnœa and cyanosis were now prominent features.

DISCUSSION

Cushing's syndrome is a rare condition, whereas bronchial carcinoma is a very common neoplasm. It is, therefore, possible that the two conditions may occur together without their being of necessity related. In the 7 cases described there have been few factors common to each. In Thorne's 2 cases, and in that described by Harrison and others (1957), the liver was invaded by secondary carcinomata. In the case described here it would appear that a very large mass occupied the centre of the right lobe, but its nature was not verified. In all but two of the cases reported, and including the present subject, adrenal hyperplasia has been a feature. It is now generally agreed that Cushing's syndrome is due directly to suprarenal cortical changes, either of carcinoma, adenoma, or bilateral hyperplasia. The basophilic changes in the pituitary described by Cushing are not now considered to be an aetiological factor in the condition. In all but 2 of the 7 cases described, therefore, there has been sufficient evidence in the adrenal glands to account for the syndrome. In one of the cases in which the adrenals were normal (that described by Harrison and others) the features of Cushing's syndrome were described as transient, and in addition symptoms suggestive of a carcinoid tumour were also encountered.

Since there is no evidence that bronchial carcinoma has any hormonal activity, it would appear reasonable to conclude that the two conditions may be encountered together only as a chance association.

In this particular case the curious hæmolytic anæmia associated with hepato- and splenomegaly, and the extensive ulceration of the legs, appeared to be a separate and earlier factor. It seemed very strange that the anæmia should be corrected, the jaundice subside, and the koilonychia and the leg ulcers be so rapidly relieved after adrenalectomy. Further, the progress of the bronchial carcinoma and its large mediastinal deposits was surprisingly slow. It can be assumed that the lesion was quite inoperable when the patient was first seen in December, 1955, yet she lived very comfortably for a further two years without any treatment directed at the thoracic lesion.

The progress of this patient raises three interesting problems which must remain unsolved. What relationship, if any, exists between these intrathoracic neoplasms, especially with hepatic deposits, and Cushing's syndrome? Secondly, why did the Cushing's syndrome recur so soon after a near-total adrenalectomy? Thirdly, did adrenalectomy have any effect in slowing the rate of growth of the bronchial carcinoma, which we must now assume was inoperable when the patient was first examined? It is in the hope that some light may eventually be thrown on these problems that this curious case is now reported.

SUMMARY

A case of Cushing's syndrome associated with carcinoma of the bronchus is described. Improvement of the Cushing's syndrome was observed after subtotal adrenalectomy, but the condition recurred within eight months of operation.

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INCARCERATION OF A MECKEL'S INGUINAL HERNIA IN AN INFANT

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In this report, a case of an incarcerated inguinal hernia is described. The hernial sac was found to contain, in addition to ileum, a Meckel's diverticulum which had obviously been the cause of the incarceration.

Before describing this case, I think that a brief note on the terminology of this and allied conditions is warranted. I have not used the term 'Littre's hernia' to describe this condition. It is a debatable point as to whether 'personal appellation' is a good method of description; it is certainly an ingrained tradition in medical education and ensures that the great names in surgery are not forgotten, but if we use these terms our definitions must be precise lest confusion arises. That confusion does arise can be seen from a review of the literature. In an article by Lazarus (1949), the terms 'Littre's hernia' and 'Richter's hernia' are used synonymously. How confusion arose in these terms can be seen from a short historical survey of these conditions.

In the original article of 1700 by Littre, whose name, despite popular belief, has no accent on the terminal 'e', three cases were described in which the sole content of a strangulated inguinal hernia was a diverticulum. The first case was not recognized clinically as a strangulation and the condition was noticed at the post-mortem. Littre, unaware of the congenital origin of this diverticulum, believed that it was formed by the stretching of one side of the bowel wall abutting against the hernial orifice. He described the appearance of the diverticulum as resembling a branch of a tree arising from the trunk.

Eighty-five years after this report, Richter described the true partial enterocoele, and in 1809 Meckel published his work on the diverticulum that now bears his name. It was then realized that the diverticulum described by Littre was, in fact, a Meckel's diverticulum.

After this the term 'Littre's hernia' was used to describe a hernia containing a Meckel's diverticulum and 'Richter's hernia' a true partial enterocœle, but there was often and still is some confusion in the use of the terms, despite Treves's clear definition of them (Keynes, 1956).

Since then, 'Littre's hernia' has often been used to describe any hernia containing a Meckel's diverticulum, but as Davies (1954) and Payson, Schneider, and Victor (1956) have suggested, the term 'Littre's hernia' originally described a sac containing a Meckel's diverticulum only and should be restricted to that definition. This is essential for the purposes of accurate recording of the incidence of this condition and also because the symptomatology, should a Littre's hernia become strangulated, is very different from the picture when bowel is present in the sac as well as the diverticulum. Littre's original description of this difference cannot be improved upon. I can see no further advantage in confining this term to strangulated herniæ only, for we would then have to find another name for the non-strangulated variety.

If there is in a hernial sac contents in addition to a Meckel's diverticulum, Davies's suggested term 'Meckel's hernia' would seem to be appropriate, and having these clearly defined terms would end any further confusion in nomenclature.

CASE REPORT

A male infant of 7 weeks was admitted with a short history of vomiting and a mass in the right groin. Since birth the child had suffered from frequent and severe attacks of wind. His bowels acted twice a week, the last movement being three days before admission. The evening prior to admission his mother had noticed a mass in his groin and he began vomiting back his feeds and small quantities of bile-stained fluid.

FIG. 514.—Illustration of the operative findings.

On examination, the child did not appear to be in pain and was not dehydrated or shocked. The pulse-rate was 120 and of good volume. The abdomen was not distended; there was no visible peristalsis and bowel sounds were normal.

There was a tense mass in the right side of the scrotum that was obviously a hernia. This was transilluminable, as herniæ often are in the young.

A diagnosis of incarceration was made; the cot was tipped and the child sedated with chloral hydrate. Later, a gentle attempt at taxis was made. Most of the mass reduced into the abdomen, but after reduction a smaller firmer mass could be felt just below the external ring. This resisted all attempts at reduction and appeared to cause the child distress when handled.

Within a short time the hernia had redescended, and a further attempt at taxis failed completely. Later, the child commenced vomiting and the pulse-rate began to rise. It was decided that strangulation was imminent and operative reduction was indicated.

OPERATIVE FINDINGS.—A standard exposure revealed an indirect inguinal hernial sac. When opened, congested but viable small bowel presented. Gentle traction on the presenting loop revealed a Meckel's diverticulum, about 4 cm. long and of the wide-mouthed variety (*Fig.* 514). The diverticulum shared in the general congestion but did not appear to be pathologically inflamed. It was

adherent to the posterior wall of the sac just distal to the neck; the adhesions were filmy and easily broken down. The loop of ileum showed early constriction rings and it was evident that if left strangulation would have occurred.

In view of the age of the child, the non-pathological appearance of the diverticulum, and the general congestion, it was felt wiser not to attempt excision of the diverticulum, and after stretching the neck of the sac the bowel was returned to the abdomen. The child made an uninterrupted recovery.

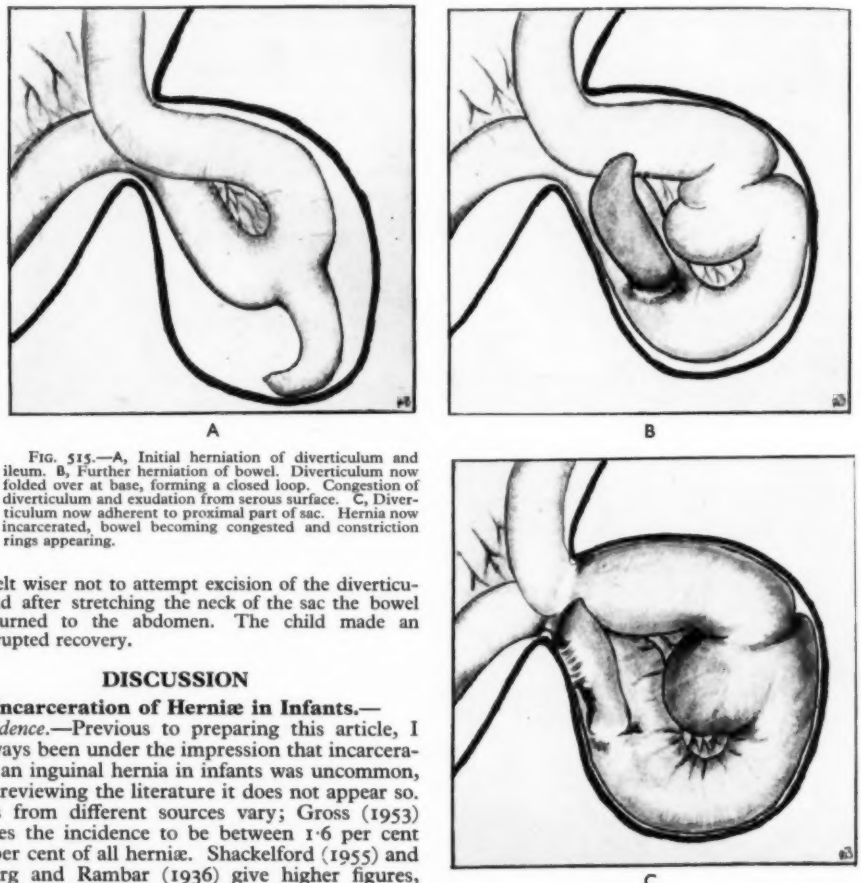

FIG. 515.—A, Initial herniation of diverticulum and ileum. B, Further herniation of bowel. Diverticulum now folded over at base, forming a closed loop. Congestion of diverticulum and exudation from serous surface. C, Diverticulum now adherent to proximal part of sac. Hernia now incarcerated, bowel becoming congested and constriction rings appearing.

DISCUSSION

1. Incarceration of Herniæ in Infants.—

Incidence.—Previous to preparing this article, I had always been under the impression that incarceration of an inguinal hernia in infants was uncommon, but on reviewing the literature it does not appear so. Figures from different sources vary; Gross (1953) estimates the incidence to be between 1·6 per cent and 6 per cent of all herniæ. Shackelford (1955) and Goldberg and Rambar (1936) give higher figures, 10 per cent and 13·6 per cent respectively.

All authorities consulted, however, agree that strangulation subsequent to incarceration is rare (Frazer, 1926; Edwards, 1936; Stem and Jones, 1950). Again there is general agreement that approximately 80 per cent of incarcerations can be reduced by the combination of tipping, sedation, and gentle taxis (Shackelford, 1955; Gross, 1953; Frazer, 1926; Edwards, 1936). This is probably due to the fact that most of these herniæ are enterocœles and adhesions between the sac and contents are uncommon (Frazer, 1926; Watson, 1948).

Age.—The age at which these infantile herniæ are most liable to become incarcerated would appear to be early in life. The figures collected by Rendle-Short and Havard (1954) and Thorndike and Ferguson (1938) show that the majority occur during the first three months of life.

Sex.—Males predominate in all series. In most female cases reported a tube and ovary were in the sac; this was the case in the only two female incarcerations in infants encountered by James (1957) that required operative reduction.

Aetiology.—Goldberg and Rambar (1936) stress the role of persistent crying, cough, breath-holding, and phimosis, all of which tend to raise intra-abdominal pressure. Whether prematurity has any relationship with the incidence of simple and complicated herniæ is undecided, various authorities disagreeing. Certainly in this case the child was premature and had suffered from frequent bouts of wind and abdominal distension.

2. Meckel's and Littre's Herniæ.—

Incidence.—The likelihood of finding a Meckel's diverticulum in an incarcerated or strangulated hernia is small. Lind (1933) regards it as so small that he considers all cases are worthy of being reported.

The gross incidence of the existence of a Meckel's diverticulum *per se* is roughly just over 1 per cent.

Christie (1931) and Lind (1933), in two large series of post-mortems, found it to be 1·1 per cent and 1·3 per cent respectively.

The incidence of a complicated hernia containing a Meckel's diverticulum is estimated by Frankau (1931) as 0·6 per cent. Watson (1948) quotes 211 cases, of which 4 were under 1 year old. He found that males predominated (62·5 per cent) and that the hernia was usually a right inguinal one. It has been described in virtually every type of hernia; Ingle and Hopkins (1952) recently described one found in a lateral femoral hernia.

Watson (1948) also found that in most cases the diverticulum was adherent to the sac wall, and Goldberg and Rambar (1936) noted that in some cases the presence of the diverticulum at the neck of the sac prevented the reduction of the hernia by taxis. This was certainly the case in this instance.

Diagnosis.—The question arises as to whether an accurate pre-operative diagnosis can be made. Lind (1933) states that "when a non-strangulated hernia causes abdominal distress and at the same time is sensitive to pressure, one should bear in mind the possibility of a Meckel's diverticulum adherent to the sac wall".

In this case it was noted that after taxis a small mass remained which was irreducible and seemed more sensitive to pressure than the reduced contents of the hernia, but the possible significance of this finding was not appreciated at the time.

Certainly, if one suspected an adherent diverticulum, it would be unwise to persist in conservative treatment too long, as its presence would in all probability increase the risk of strangulation occurring. To some extent, the point at which the diverticulum is adherent is important. If it is stuck to the apex of the sac, although it would render the hernia non-reducible, it is not likely by itself to precipitate strangulation, but if, as in this case, it is adherent in the region of the neck of the sac, then it is in a potentially dangerous site. In retrospect, it is now possible to correlate the clinical findings after the first attempt at taxis with this state of affairs.

Why does the Diverticulum become Adherent?—One final point of interest remains. Most reports show that the diverticulum becomes adherent to the sac wall. If the organ is pathological then this is understandable, but why should a non-pathological diverticulum, which is to all intents and purposes normal bowel, become adherent while the remainder of the bowel does not?

I think that the answer lies in the fact that because of the anatomy of the diverticulum it can easily become a closed-loop obstruction.

If the condition at initial herniation is visualized in diagrammatic form (*Fig.* 515 A), then as more bowel enters the sac it is easy to postulate the state of affairs shown in *Fig.* 515 B, where the diverticulum has been displaced so that its apex points to the neck of the sac and its base is kinked and constricted. It is then a closed-loop obstruction, venous congestion will occur, and later exudation with the formation of fibrinous adhesions between it and the peritoneum of the sac. Eventually the state in *Fig.* 515 C is reached. The adherent diverticulum now obstructs the neck of the sac and strangulation is imminent or at least could easily be precipitated by minor trauma such as attempts at taxis.

SUMMARY

1. A case of an incarcerated Meckel's hernia in an infant is described.

2. The terminology of this and allied conditions, including Littre's hernia, is defined.

3. A brief historical survey is made.

4. The natural history of incarcerated herniæ in infants and herniæ containing a Meckel's diverticulum is reviewed.

5. The reason why these diverticula frequently become adherent is discussed.

Acknowledgements.—I am indebted to Mr. T. G. I. James for his encouragement and advice in preparing this article. I am also grateful to Miss D. M. Barber for permission to reproduce her painting of the operative findings, and to M. C. H. A. Fleurent, of the Library of the Royal College of Surgeons, for his help in translating Littre's original article.

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UNUSUAL SKELETAL DYSTROPHY ASSOCIATED WITH A SOFT-TISSUE TUMOUR

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THE patient reported here is suffering from a unique skeletal abnormality and a soft-tissue tumour in his neck.

CASE REPORT

A boy, aged 14 years, was referred to the Surgical Out-patient Clinic of Lewisham Hospital on account of a painful swelling on the left side of his neck, and was first examined on Oct. 22, 1953. His mother stated that about a month previously he had hauled a heavy grass roller by passing a rope over his left shoulder. A week later he felt pain in the left side of his neck and his mother noticed a swelling.

On examination there was a tumour above the left clavicle. It was not considered malignant, although no definite diagnosis was made. Treatment was not considered necessary and the youth was referred back to his general practitioner for supervision.

FIG. 516.—The tumour photographed on infra-red sensitive material. Notice the enlarged veins.

He re-attended the Surgical Out-patient Clinic on Sept. 14, 1954, and was referred to the Orthopædic Department, where he was seen the next day. He stated that the lump had increased 50 per cent in size since the last visit, but that it was no longer painful.

PREVIOUS HISTORY.—When he was 6½ years old both his elbows were put in plaster. Since then he has had a deformity of both elbows.

ON EXAMINATION.—He was a boy of normal intelligence, but below average height.

In the left posterior triangle of his neck there was a large, firm, slightly tender tumour attached to clavicle and scapula (*Fig.* 516). Movements of his left shoulder were restricted.

Both elbows were dislocated and could only be extended to 90°. Movements of both wrist-joints were limited.

FIG. 517.—Radiograph of the left scapula. A number of punched-out holes are present, and the lower surface of the clavicle is eroded.

There was a bilateral pes cavus with short great toes.

Radiography.—The whole skeleton was X-rayed and the relevant abnormalities were as follows: there were a number of punched-out holes in the scapula and the lower surface of the clavicle was slightly eroded (*Fig.* 517).

Both elbows were dislocated and the lower humeral epiphyses were prematurely fused (*Figs.* 518, 519).

Both wrist-joints showed gross symmetrical changes.

The lower end of the ulna was short on each side and its epiphysis was flat and irregular. The lower radial epiphysis was flat and seemed to have been indented by the bones of the carpus (*Figs.* 520, 521).

FIG. 518.—Lateral radiograph of the patient's right elbow, showing a dislocation and premature fusion of the humeral epiphyses.

FIG. 519.—Lateral radiograph of the left elbow, showing similar changes as in *Fig.* 518.

FIG. 520.—Radiograph of the right wrist. The radial epiphysis is flat and indented by the carpal bones. Only five irregular carpal bones can be made out. The metacarpal bases are mis-shapen.

FIG. 521.—Similar changes to those in *Fig.* 520, but the base of the fourth metacarpal is markedly diminished in size.

He did not have more than five carpal bones and these were irregular in shape. The metacarpal bases were mis-shapen and this was more noticeable on the left side, where the base of the 4th metacarpal was markedly diminished in size (*Figs.* 522, 523).

His upper dorsal spine exhibited a mild scoliosis, convex to the right (*Fig.* 524).

His feet showed partial suppression of the medial tarsal bones, the scaphoid and cuneiforms forming a single bony mass to which the 1st and 2nd metatarsal bases were fused. In the 2nd and 3rd metatarsals there was a radiolucent area. The 1st metatarsal was abnormally short (*Figs.* 523, 524). The 1st phalanx of the great toe was cocked up and bifid at each end (*Fig.* 525). The 5th

toe had only two phalanges and its 1st phalanx was pointed.

Investigations.—The patient's blood-count, his serum-calcium, phosphorus, alkaline phosphatase, and his uric acid were normal.

A biopsy was performed on Sept. 21, 1954. The report was as follows: "Microscopically the tumour is composed of bundles of collagen fibres accompanied by

FIG. 522.—Radiograph of the patient's dorsal spine. A mild scoliosis convex to the right is present.

spindle-shaped cells which are fibroblasts. The appearance of the tumour is that of a fibroma; it may be that it is actually a neurofibroma, but there is no definite evidence of this. I think this tumour is essentially benign." (*Fig.* 526.)

TREATMENT.—In October the patient was referred to Sir Stanford Cade and received a course of deep X-ray therapy at Westminster Hospital.

PROGRESS.—The patient was re-examined by the writer on Sept. 7, 1955. He had no pain then and the tumour was definitely smaller. In June, 1957, the patient refused to be re-examined and his father made it clear that he would not welcome a visit to his home. It is, however, known that he is alive and well, has no pain, and is working.

The Patient's Family.—His mother stated that the patient's father, two paternal uncles, and his paternal grandmother were deformed. One paternal aunt had a crooked finger. The patient had seven brothers and sisters. One brother, aged 14 years, had crooked little fingers.

Clinical examination of the patient's mother and of two sisters, aged 6 and 8 years respectively, revealed nothing abnormal. Moreover, the skeletons of the two girls were normal on screening. The brother with the crooked little fingers was found to have slightly curved fifth digits which did not impair the efficiency of his hands. Radiography of his hands were not taken. However, he was suffering from markedly flat feet, but the radiographs of his feet did not show evidence of a skeletal malformation.

Two attempts to examine further members of the family were frustrated by the patient's father.

DISCUSSION

This patient is suffering from two abnormalities—a skeletal malformation and a soft-tissue tumour. Sir Thomas Fairbank wrote in 1954: "This is indeed an amazing case, I have nothing in my records quite like it". In view of the fact that the bony changes are symmetrical, they must be due to a congenital developmental error. It is likely that the condition is familial and hereditary, in spite of the fact that permission was not obtained to carry out an examination of the entire family. Of special interest is the patient's soft-tissue tumour. It is benign histologically and the fact that the patient is alive and well five years after the tumour was first noticed strongly suggests that it is benign clinically as well. The tumour may be regarded as a hamartoma.

His two lesions place this patient in a group of cases characterized by coexistence of a skeletal abnormality with a soft-tissue hamartoma. The best known example of this group is congenital neurofibromatosis, in which bony abnormalities occur together with subcutaneous tumour nodules. Another example is macrodactyly and macromelia, associated with multiple cutaneous hæmangiomata. Some cases of polyostotic fibrous dysplasia associated with arteriovenous aneurysm (Stauffer, Arbuckle, and Aegerter, 1941) also belong to this group.

Further examples are provided by Maffucci's syndrome, in which enchondromata in the bones of the hands and feet cause bizarre deformities. The bony lesions are associated with multiple subcutaneous hæmangiomata. (Maffucci, 1881.)

SUMMARY

A patient suffering from a unique developmental disorder and a benign cervical soft-tissue tumour is reported. There is some evidence that the skeletal abnormality is familial and hereditary.

The patient belongs to a group of cases characterized by the coexistence of a skeletal disorder with a soft-tumour hamartoma.

I am indebted to Sir Thomas Fairbank for giving me his views on this patient. The deep X-ray therapy was carried out at the Westminster Hospital under Sir Stanford Cade and I would like to thank him for his co-operation and for encouraging me to record this case. I am grateful to Mr. A. Cavendish for referring this case to me. The histological report was by Dr. M. O. Skelton; Dr. N. D. Morrison helped me with the interpretation of the radiographs and I thank them both for their assistance. For the photographs I am obliged to Mr. J. E. Andrews.

FIG. 523.—Radiograph of the right foot. Scaphoid and cuneiforms are forming a single bony mass to which the 1st and 2nd metatarsal bases are fused. In the 2nd and 3rd metatarsals there is a radiolucent area. The 1st metatarsal is normally short. The 1st phalanx of the great toe is cocked up.

FIG. 524.—Similar changes to those in *Fig.* 523. There is early osteoarthritic lipping of the bone distal to the head of the talus.

FIG. 525.—Radiograph of the patient's right forefoot. The 1st phalanx of the great toe is bifid at each end and resembles the cross-section of a four-flange hip nail. The 5th toe has only two phalanges and the distal end of the 1st is pointed.

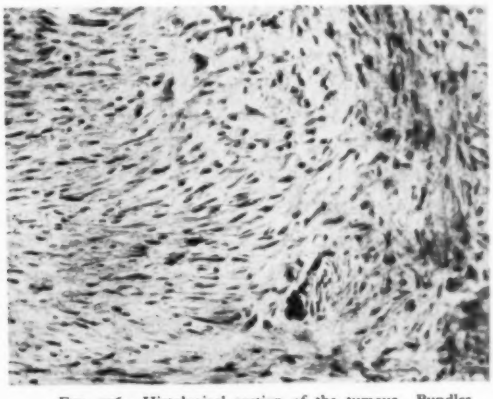

FIG. 526.—Histological section of the tumour. Bundles of collagen fibres and spindle-shaped fibroblasts are present. H. and E. (×104.)

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TERATOMA OF THE NECK IN RELATION TO THE THYROID GLAND

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TERATOMAS of the neck are rare, and Willis (1953) classes them with those of the pineal gland and brain as the most uncommon of teratomas. In this century only five papers have appeared in British literature on these tumours, namely those by Carter, 1903; McGregor and Workman, 1906; Russell and Kennedy, 1913; Daniels, 1928; and St. George Wilson, 1939. The paper by Daniels in the BRITISH JOURNAL OF SURGERY has been neglected in subsequent reviews. Sir John Bland-Sutton (1917), in his famous book *Tumours, Innocent and Malignant*, showed "the section of a head of fœtus with the thyroid replaced by a teratoma drawn from a specimen in the Museum of St. Thomas's Hospital".* Joll (1932) described another example in a female infant from a specimen in the Museum of the Royal College of Surgeons.† Sir Thomas Dunhill (1956) had never encountered such a tumour in his wide experience of thyroid surgery, and no specimens have been found in twelve major pathology museums in England and Scotland.

Teratomas are true neoplasms composed of multiple tissues of kinds foreign to the parts in which they arise. They display some degree of progressive inco-ordinated growth and have to be separated from non-neoplastic malformations which may contain heterotopic tissues (such as branchial cysts and enterocysts), and from monsters and duplications of main parts (Willis, 1953). It is doubtful therefore that when Grassi in 1691 described the removal of a completely developed fœtus the size of a finger from a swelling in a woman's neck that this was a teratoma of the neck, though it has frequently been cited as the first reported. The tumour in a neck described by Joube in 1759 which contained cartilage and bone was more possibly a teratoma, but this, and several other early reports, including the earliest possible example in British literature reported by Bury in 1834, cannot be accepted as such from lack of microscopical proof.

The first proved teratoma of the neck was described by Hess in 1854. Later Wetzel (1895) re-examined the specimen and confirmed the diagnosis. Shattock in 1882 described the next proved example and since then the more important accounts have been by Poult (1905), Hunziker (1909), Pellegrini (1913), Ehlers (1914), Saphir (1929), Pusch and Nelson (1935), and Bale (1950). Bale reviewed 56 teratomas of the neck (with 5 other possible examples) and added 4 more of his own. To these must be added those of Shattock (1882) and Daniels (1928), and those in subsequent reports, namely 4 in McGoon's paper (1952) (with 2 other possible

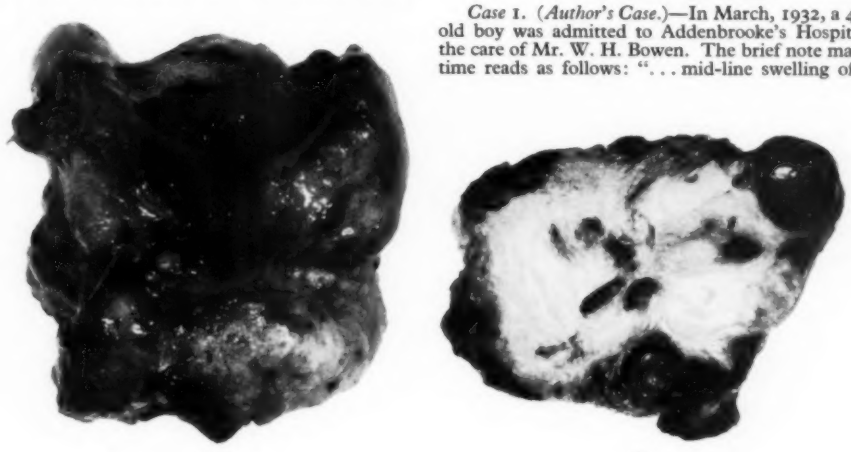
FIG. 527.—Specimen in the Museum of St. Thomas's Hospital, a drawing of which appeared in Sir John Bland-Sutton's book, *Tumours, Innocent and Malignant* (1917). By the kindness of Dr. Roland John the specimen was re-examined and sections cut. It is now thought that the tumour is not a teratoma of the neck but a hamartoma arising from the region of the pharyngeal floor. (Section of the head of a fœtus with tumour in neck.) (× ¼.)

* By the kindness of Dr. Roland John this specimen (*see Fig.* 527) was re-examined and sections cut. The histology was difficult owing to autolysis before fixation but showed cartilage and bone embedded in fibrous connective tissue in which there were also many spaces lined by epithelium. The spaces varied in size from small acini to large cysts; the epithelium showed all transitions from simple cubical to ciliated columnar of a 'respiratory' type. No thyroid tissue or glia was seen. This histological picture is similar to that seen in the cervical teratoma described in *Case* 2 of this paper, but on the other hand, as no tissues definitely foreign to the neck were seen, Dr. John considers that it should be called a hamartoma rather than a teratoma. From his examination of the specimen he thought that it could well have arisen from the region of the pharyngeal floor.

† This specimen was given to the College by J. Hutchinson, junior, in 1898, and was destroyed in the 1939–1945 war. There was apparently some doubt as to the origin of the tumour and it may have been a teratoma arising at the base of the skull.

examples quoted), and 1 each in the papers by Perkins and Pautler (1953), Otken (1953), and Buckwalter and Layton (1954). (*Table I.*)

All but 3 of the 69 cervical teratomas now reviewed here occurred in stillborn fœtuses, newborn infants, or in the first year of life. Three of the tumours have been in adults (Lurje, 1908; Fritzsche, 1920; Buckwalter and Layton, 1954), and these were all malignant, as was another possible example in an adult described by Waechter (1909) and quoted by Fritzsche. Only 1 of the tumours occurring early in life was malignant, that reported by Pupovac in 1896. The present paper reports a teratoma of the neck in a man aged 23 years which is apparently unique both by being recurrent and by being benign in an adult. Another tumour in a stillborn child is also reported, the details having been kindly given by Dr. N. F. C. Gowing of St. George's Hospital.



A B

FIG. 528.—Benign recurrent teratoma of the neck from an adult (*Case* 1). A, External view from behind and medially. To the left and above can be seen the upper part of the right lobe of the thyroid gland with a parathyroid gland lying on its surface. B, Cut surface of removed tumour showing stroma of white fibrous tissue with cysts. (*Natural size.*)

Table I.—SUMMARY OF TUMOURS REPORTED SINCE 1950 OR NOT INCLUDED IN BALE'S REVIEW

No.	Author	Year	Age	Sex	Thyroid Tissue in Tumour	Nervous Tissue in Tumour	Displacement of Thyroid Gland	Operation	Arterial Blood-supply of Tumour
1	Shattock	1882			No ref.	No ref.	No ref.	?	No ref.
2	Daniels	1928	5 wk.	M.	No	No ref.	No thyroid on left	Yes (death)	Superior and inferior thyroid
3	McGoon	1952	6 mth.	F.	No	Yes	No	No	No ref.
4	McGoon	1952	6 wk. prem.	F.	No	Yes	Right half thyroid indistinct	No	No ref.
5	McGoon	1952	8 mth.	M.	No	No	No ref.	Yes	No ref.
6	McGoon	1952	2 wk.	M.	No	Yes	No	No	No ref.
7	Perkins and Pautler	1953	6 d.	F.	Yes	Yes	No right lobe of thyroid	Yes	Probably superior and inferior thyroid
8	Otken	1953	3 wk.	M.	Yes	Yes	Yes	Yes	Superior thyroid
9	Buckwalter and Layton	1954	23 yr.	F.	No	Yes	Right lobe replaced	Yes	Superior and inferior thyroid
10	Keynes	1959	24 yr.	M.	Yes	Yes	Yes	Yes	Superior thyroid
11	Keynes	1959	4 wk. prem., stillborn	M.	No	Yes	No thyroid identified separate from tumour	No	?

CASE HISTORIES

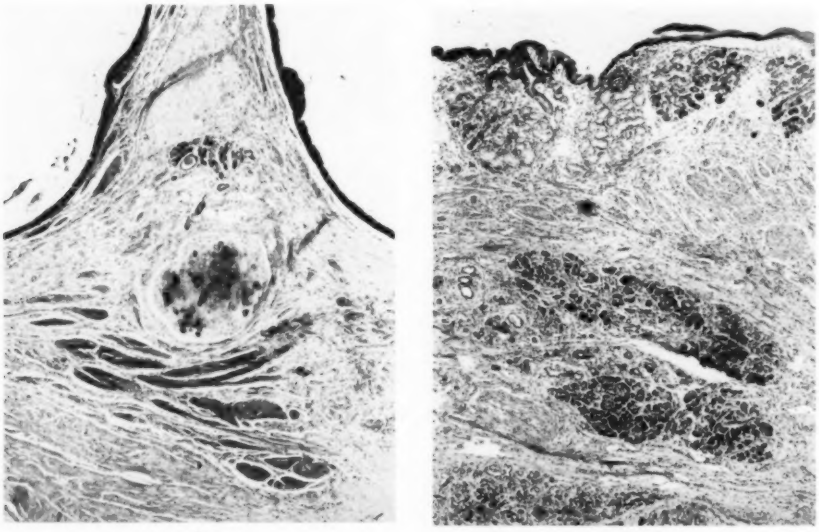
Case 1. (*Author's Case.*)—In March, 1932, a 4-month-old boy was admitted to Addenbrooke's Hospital under the care of Mr. W. H. Bowen. The brief note made at the time reads as follows: "... mid-line swelling of thyroid present since birth. Has been growing larger. Difficulty with respiration. At operation, March 10, 1932, whole gland seemed to be diseased. Congenital colloid type. About two-thirds gland removed." The infant left hospital 14 days after operation. The pathological report by Dr. C. H. Whittle reads as follows: "This tumour contains cartilage, muscle, glandular tissue, and possibly nervous tissue. I think this is of teratomatous nature." Unfortunately the sections have since been destroyed.

In January, 1956, the patient, now a fit-looking young man aged 24, was seen again in Addenbrooke's Hospital. He gave a history of a swelling in the right side of the neck for one year which varied in size. He had had an ache in the neck with discomfort on swallowing for three months. On examination there was a soft lobulated swelling on the right side of the neck which moved on swallowing and was attached to the thyroid cartilage. It lay just above a low transverse scar. In view of the report of 1932 a diagnosis was made of recurrent teratoma of the thyroid gland.

On Feb. 28 the neck was re-explored by Mr. B. M. Truscott. On the right the tumour was adherent to the strap muscles, and these were divided above and below it. The tumour was then mobilized from the trachea and carotid sheath, with division of the superior thyroid vessels. The inferior thyroid artery was not seen. Finally the tumour was removed after division of the isthmus of the thyroid on the left. The removed specimen had a block of strap muscle attached to it in front and some normal-looking thyroid tissue above and behind (*Fig.* 528). The patient left hospital two weeks after operation and when seen at follow-up in May, 1957, was well and without any evidence of recurrence.

The macroscopical report on the specimen* was as follows: A mass of tissue measuring 5 × 5 × 4 cm. with an irregular surface, in part smooth and lobulated, resembling normal thyroid, but in other parts a tough, white, and fibrous cut surface. Transection shows a stroma of white fibrous tissue in which are cysts up to 1 cm. in diameter, some containing clear mucus and others white or yellow gelatinous material. In the centre is a cavity 1·5 × 1·5 cm. lined by epithelium approximately 0·1 cm. thick. This epithelium is rough and resembles mucosa rather than skin. The areas of ostensibly normal thyroid tissue are in part large cysts, but at one end is a nodule 4 × 2·5 × 2 cm. of pinky-brown tissue with much colloid. On this is a small brown nodule (? parathyroid).

The microscopical report by Dr. A. M. Barrett was as follows: A teratoma containing thyroid tissue, voluntary and involuntary muscle, gastric and intestinal mucosa,



A B

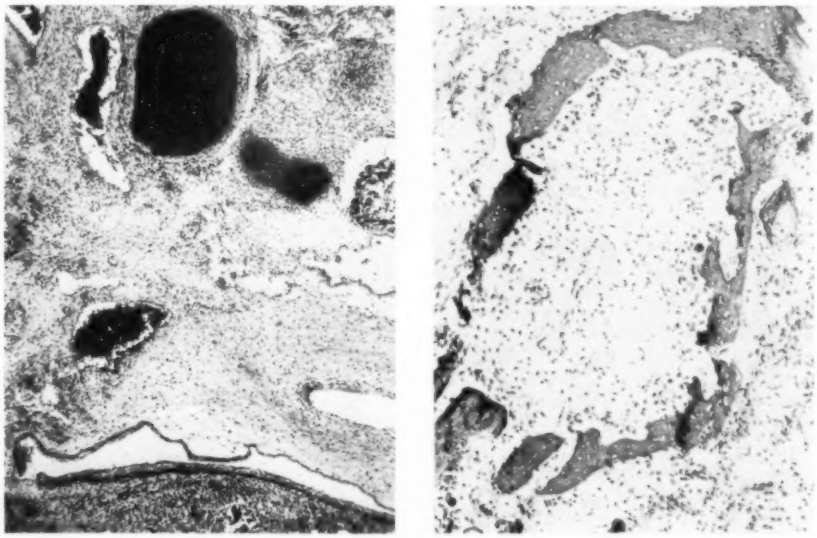
FIG. 529.—Benign recurrent teratoma of the neck in an adult (*Case* 1). A, Photomicrograph showing mixed structure of tumour with epithelium, cartilage, and striped muscle. H. and E. (× 28.) B, Photomicrograph showing pancreatic tissue, smooth muscle, mucous secreting glands, and various types of epithelium. H. and E. (× 32.)

FIG. 530.—Stillbirth with teratoma of the neck (*Case* 2). (*Photograph taken at St. George's Hospital and reproduced by the kindness of Dr. N. F. C. Gowing.*)

* Now in the Museum of the Royal College of Surgeons of England.

pancreas, stratified and ciliated columnar epithelium, cartilage, glial tissue, etc. No evidence of malignancy. The brown nodule is a normal parathyroid gland (*Fig.* 529).

Case 2. (*Dr. N. F. C. Gowing's Case.*)—The mother, aged 36 years, had had five previous pregnancies which were all normal. Apart from some anæmia the sixth pregnancy was normal until 30 weeks when she developed acute hydramnios. Three plain radiographs showed persistent extension of the head. Abdominal paracentesis was performed twice and surgical induction of labour at 32 weeks. Finally on April 27, 1955 a stillborn child was delivered with difficulty owing to its extended head and arms. There was no history of rubella infection or of exposure to irradiation.



A B

FIG. 531.—Teratoma of the neck in a stillbirth (*Case* 2). A, Photomicrograph showing area of cartilage, doubtful area of glia, and epithelium. H. and E. (× 30.) B, Photomicrograph showing bone and mesenchyme. H. and E. (× 80.)

On examination the stillbirth had a large tumour of the neck (*Fig.* 530). On microscopy this tumour showed a variety of tissues, including cartilage, bone, deposits of calcium, incompletely differentiated mesenchyme, squamous, cubical, columnar, and transitional epithelium, pigmented epithelium which was possibly retinal, and one doubtful focus of glia (*Fig.* 531). No thyroid tissue was seen in the tumour or identified separately from it. The relationship of the thyroid arteries to the neoplasm is not known.

PATHOLOGY

Teratomas of the neck are usually noticed at birth or found in premature or stillborn fœtuses. They are usually large and lie either in the midline or to one side of the neck, with the skin freely mobile over the mass and in close relation to the thyroid gland. They are partly solid and partly cystic growths which contain a variety of differentiated tissues including nervous tissue, striated muscle, cartilage, and various epithelia. Potter (1938) lists fifteen types of tissue in the tumour she reported under the headings of (1) general types, (2) cysts, and (3) attempts at organ formation. Many authors have stressed the presence of nervous tissue in teratomas of the neck, but this is not a particular feature since Willis (1936) states that it is present in at least four-fifths of all teratomas. Thyroid tissue is not unusual in ovarian teratomas as 'ovarian goitres' (Nicholson, 1937), but is only occasionally seen in other teratomas (Willis, 1953). Its presence in cervical teratomas is not common since it was only present in 9 out of 71 tumours.

Budde (1926) held that the distribution of teratomas in preaxial median or nearly median positions strongly suggests disturbances arising in the primitive streak and its derivative the notochord. Teratomas of the anterior mediastinum and neck would appear to be exceptions to this concept, but in early embryos there is no neck, and the rudiments of the heart and neck lie close to the oral region so that disturbances might easily be transmitted to them from the anterior end of the notochord. "It is significant that most cervical teratomas affect the thyroid gland which is a derivative of an outgrowth from the oral entoderm close to the oral membrane" (Willis, 1953, p. 980).

Schlumberger (1946) does not agree with this hypothesis for the origin of anterior mediastinal teratomas, and thinks they arise from local dislocations of tissues during 'embryogenesis' of the thymus and should more accurately be called 'teratomas of the thymus'. With this analogy and on similar reasoning cervical teratomas could be called 'teratomas of the thyroid gland'.

In 13 of the 71 tumours in this review no reference was made, save in one, to the thyroid gland or to other positive relationships; in 58 all or part of the thyroid gland was replaced by tumour. Bale

(1950) stated that the replacement of thyroid tissue "is not pressure displacement of the gland as is seen in other tissues of the neck; on the contrary, there is actual absence of part or all of the thyroid gland with tumour occupying its place". He thought that where the blood-supply of the tumour had been mentioned it suggested that tissue which might have become thyroid tissue had developed into a teratoma. He therefore called the teratomas of the neck with a known blood-supply from the thyroid arteries (13 examples) 'teratomas of the thyroid gland', but the 45 tumours which displaced the thyroid gland and where the blood-supply was unknown he named 'teratomas of the neck in the region of the thyroid gland'. The remainder (13 examples) he called 'teratomas of the neck probably in the region of the thyroid gland'.

At present this subdivision of teratomas of the neck can serve little purpose until a larger number of tumours with a known blood-supply is available. The thyroid gland is usually involved when there is a teratoma in the neck and the records are sufficiently specific on this point, but it is probably wiser (and in keeping with the naming of extragonadal teratomas elsewhere in the body) still to use the term 'teratoma of the neck' to include all cervical teratomas. Later teratologists may be able to settle their differences (which may not be very real) and confirm the academic point whether or not all teratomas of the neck are teratomas of the thyroid gland.

MALIGNANT DISEASE IN CERVICAL TERATOMAS

Nearly all teratomas are discovered at birth or in early childhood and it is clear that most or all of these arise at early stages of embryonic development. Later discovered teratomas are usually ovarian, testicular, or mediastinal, in sites where they can grow to a large size before giving symptoms, and are slow growing and benign. A small benign teratoma may lie quiescent for years and then a general acceleration of the proliferative activity of all its tissues may transform it into a structurally 'embryoma' and clinically malignant tissue (Willis, 1953). The age incidence of cervical teratomas follows this plan in that only 4 of 71 tumours in this review were not discovered in infancy or childhood and these were all malignant with the exception of the recurrent tumour reported here. Only 1 of 67 of the infantile tumours was malignant.

A malignant tumour may develop from an embryonic teratoma where the malignancy is a property of the whole growth shared by *all* its immature tissues (though not necessarily in equal degrees) and giving metastases of a composite structure. It may also arise in a benign cystic teratoma from one of the previously quiescent tissues of the growth. This is usually a squamous-cell carcinoma arising from skin in the tumour. Rarely a sarcoma may develop, though Willis (1953) considers that in the past this may have been a label incorrectly given to an anaplastic carcinoma or to an embryonic malignant teratoma. In view of this the mention of sarcoma in the metastases in the case reports which follow must be considered to be unsatisfactory, but unfortunately the information which has survived is insufficient to make a reassessment. In 71 cervical teratomas there were 4 malignant tumours, or an incidence of about 5 per cent. This low incidence of malignancy possibly reflects the fact that cervical teratomas either occur in stillbirths or are usually easily discovered and removed in infancy before malignant change is likely to occur.

Lurje (1908) reported a 52-year-old woman who died of metastatic 'sarcoma' from a malignant cervical teratoma. The metastases only showed 'sarcoma' but the primary tumour had a complex structure containing bone, cartilage, muscle, neuroglia, and epithelial tissue. Waechter (1909) described a 'sarcoma' of the thyroid in a 71-year-old innkeeper which he thought had arisen in an embryological remnant. This tumour showed a granular tissue with epithelial cell nests, calcified cartilage, and bone lying in a fibrous and necrotic stroma. His original paper has not been traced and this tumour was not definitely a teratoma. Fritzsche (1920) reported an undifferentiated cervical teratoma in a woman aged 41 years. At operation the tumour was only partially removable after ligation of the superior thyroid artery. The autopsy examination 36 days later showed 'sarcoma' in the lungs, but epithelial elements as well as 'sarcoma' in the bone-marrow. Metastases in the lymph-nodes showed a similar but simpler structure than the primary growth.

Buckwalter and Layton (1954) described a malignant teratoma in the thyroid gland of a woman aged 23. There was a six-month history of a gradually enlarging lump in the right side of the neck, and a diagnosis was made of carcinoma of the thyroid. At operation the tumour received its blood-supply from the right thyroid arteries. A total thyroidectomy and right block dissection of the neck was carried out but some growth was left. Four months later she developed metastases in the neck and mediastinum which responded to radiotherapy, though she died eleven months later. The operation specimen showed an undifferentiated teratoma involving all the right lobe and most of the left lobe of the thyroid. A similar structure was found in the involved lymph-nodes.

Besides the adult and malignant teratomas of the neck already described there has been one infantile malignant teratoma reported by Pupovac (1896). Here a nine-week-old male infant was admitted to hospital for removal of a mobile tumour in the left side of the neck which had been present since birth and which had gradually become a little larger. A diagnosis was made of cystic hygroma. At operation the tumour was easily enucleated but there were some enlarged lymph-nodes near it which were removed with the left lobe of the thyroid gland. The baby died a few hours after operation, the cause of death not being clear. Examination of the tumour showed a teratoma containing striped and smooth muscle, cartilage, bone, and mesenchyme with various forms of epithelium. With the more differentiated tissue were areas of undifferentiated embryonic connective tissue and nervous tissue. The lymph-nodes showed the same histological picture as the main tumour, but particularly the embryonic nervous tissue.

SYMPTOMS, SIGNS, AND DIAGNOSIS

The presentation of a cervical teratoma is almost invariably one of a lump in the neck discovered at

birth, or perhaps causing an impacted or difficult labour. With this there may be tracheal and œsophageal compression, and death in the unoperated examples has usually been from respiratory distress. The differential diagnosis has usually been either congenital goitre or cystic hygroma. A congenital goitre will be very often similar to a cervical teratoma as it, too, may be lobular, cystic, in the midline or to one side of the neck, and may cause tracheal compression. It will not, however, contain areas of calcification. Cystic hygromas may achieve equal size but are typically less firm and usually arise in the posterior triangle of the neck. Thyroglossal cysts are usually smaller, fluctuant, and unilocular. Tumours of any of the soft tissues of the neck such as angiomas of the strap muscles may produce similar masses to cervical teratomas. These, however, will be distinct from the thyroid gland.

The sex incidence has been equal. As with many congenital anomalies, hydramnios has been a common association, and there has been a known incidence with 14 out of 71 cervical teratomas or about 20 per cent (the expected normal incidence being 0·5 per cent).

TREATMENT AND RESULTS

A surgical procedure was performed in 36 of the 71 cervical teratomas. These 36 operations include those on 3 of the 4 adult tumours. Of the remaining 33 operations, which were all on babies under 8 months, there were 4 unexplained post-operative deaths (Pupovac, 1896; van Rey, 1916; Hadda, 1921; Daniels, 1928) leaving 29 presumed cures (in all reports the follow-up period had been short). Of the 4 adult patients 2 died from recurrences of their malignant growths following surgery (Fritzsche, 1920; Buckwalter and Layton, 1954) and 1 had no operation but died from a malignant growth (Lurje, 1908). The adult patient reported in this paper has had the only recurrence so far discovered following surgery as an infant and in addition the only adult cervical teratoma which has been benign.

Of the 34 infantile tumours which were not treated by surgery 16 occurred in stillbirths. Of the remaining 18, 16 died within a few days of birth before surgery could be carried out. One baby died aged one month from suffocation produced by an enlarging tumour (Carter, 1903), and another aged six months from pneumonia (McGoon, 1952). Thus in 51 born alive 33 had operations, or two-thirds, and the mortality from this was only 4, or 12 per cent. From these figures it is clear that if the baby is a fair surgical risk the tumour may be removed with the likelihood of a good result.

SUMMARY

This review includes 69 teratomas of the neck from the literature with 2 further examples, one being the first recurrent tumour yet described and the only known benign teratoma of the neck in an adult.

Only 4 of 71 tumours occurred in adults and these were all malignant with the exception of the one now reported. Sixteen of the remaining 67 tumours were found in stillbirths and of the rest most were noticed within a few days of birth. Thirty-three of the tumours were removed surgically with 4 deaths, but the 18 babies in whom no surgery was performed all died within a short time from respiratory distress. Only 1 of these infantile tumours was malignant. Hydramnios has been a common association.

The pathology and differential diagnosis of teratomas of the neck are considered with special emphasis on malignant disease. The conclusion is reached that at present, though some or even all of these tumours may be teratomas of the thyroid gland, it is best to call all of them 'teratomas of the neck'.

Addendum.—Since this paper was written an article by H. O. Thomas on cervical teratoma has appeared in the BRITISH JOURNAL OF SURGERY (1957). This mentions the enucleation of a teratoma from the neck of a male infant aged 3 months, with subsequent death a few hours later. In greater detail it relates of the removal of an encapsulated teratoma from the right side of the neck of a female infant aged 4 months, where the teratoma did not have an arterial blood-supply from either the thyroid artery nor any attachment to the thyroid gland. It also mentions two further teratomas of the neck in the literature (White and Gosselin, 1952 ; and Hinds, Seybold, and Walker, 1954).

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APPENDIX DUPLEX

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DUPLICATION of part of the alimentary tract is a condition of great embryological interest which is met only infrequently in surgical practice. Examples are more commonly seen in infants and children, and the grosser manifestations are usually incompatible with survival into adult life.

Duplication of the appendix is unusual, but sufficient cases have been recorded at operation or autopsy to permit some attempt at classification. With regard to the degree of duplication involved, Cave (1936) describes three varieties: partial duplication of the appendix; two separate appendices arising from a single cæcum; and duplication of both appendix and cæcum.

On theoretical grounds it seems possible to have numerous varieties of partial duplication. If there is complete separation of the two channels over part of the length of the appendix, this separation may be proximal, distal, or in the middle. Furthermore, each channel may be completely separate or share a serous or muscle coat to a varying degree. Some of these possible variations have been described in the literature. Rosenberger (1903) described the occurrence in an adult male of an appendix with a double lumen separated by a fibrous septum lined with mucosa; Walthard (1931) described a female infant whose appendix had a double lumen in the middle only, with a common serous and muscle coat at this point; Elwyn (1924) discovered one at operation where there were two completely separate channels at the cæcal end; and Clavel and Colson (1933) described another with a bifid tip.

This last type is similar to other cases described as congenital diverticula of the appendix, e.g., Walmsley (1929). However, it is probable that these are really examples of partial duplication, as Edwards (1934) has demonstrated that appendix diverticula are due to herniation of mucosa through an area of acquired weakness in the wall of the organ.

The second type described by Cave (1936) has two completely separate appendices attached to a single cæcum, and Waugh (1941) describes a case where the second appendix arose from one of the tæniæ, and cites several others. The identity of this second structure must be established by histological demonstration of a normal appendix structure with lymphoid tissue, as a Meckel's diverticulum may arise from an unusual site. Hadley and Cogswell (1936) describe one which arose from the base of the appendix, its identity being shown beyond doubt by the presence of a cord-like attachment to the umbilicus.

In cases where the cæcum is duplicated, there may be extensive duplication of the mid and hind gut and that of the appendix itself is merely an incidental finding. Ravitch (1953) collected 20 cases of colonic duplication, in half of which the appendix was also duplicated. The length of bowel involved included part of the ileum in some cases, and the rectum in others. In the majority, the accessory lumen was lateral to the main channel and ended blindly at the level of the pelvic colon.

In addition, 12 cases had a major duplication of the lower urinary tract and 13 showed anomalies of the lower genital tract. Where the uterus was duplicated, each portion was unicornuate with a separate vagina and a single tube and ovary attached to each horn. Three cases had anomalies of the vertebral column and, in two of these, the column was duplicated from L.3 caudally. From the evidence he presents, Ravitch suggests that these major duplications are caused by partial twinning or by incomplete fusion of two individuals.

As previously mentioned, few appendix duplications are seen in adults (e.g., only 3 of Ravitch's 20 cases), but they may be discovered at operation for acute appendicitis. Saleeby, Zollinger, and Ellison (1954) described a 35-year-old woman with duplication of terminal ileum and colon, in whom one of two separate appendices showed acute inflammatory changes.

The appendix described in this report has a structure similar to that described by Elwyn (1924), and was discovered at operation for acute appendicitis.

CASE REPORT

A 40-year-old woman was admitted to this hospital on March 5, 1956, complaining of abdominal pain which had begun 30 hr. previously in the umbilical region and had later shifted to the right iliac fossa. On examination, tenderness and rigidity were present in the right iliac fossa, and a diagnosis of acute appendicitis was made.

FIG. 532.—Photograph of the fixed specimen showing the narrower accessory lumen at the base of the appendix.

At operation, the appendix lay below the cæcum and was acutely inflamed. The appendix was seen to arise from a bifid stem (*Fig.* 532), the thicker of the two channels arising from the normal site at the junction of the tæniæ, and the thinner ($\frac{1}{4}$ in. diameter and $\frac{1}{2}$ in. length) from the posterolateral aspect of the cæcum. The secondary channel was divided at its junction with the cæcum, and the patency of its communication proved before closure. Thereafter, the appendix was removed in a normal manner and the wound was closed. Convalescence was uneventful.

On histological examination the mucosa of the appendix was extensively destroyed and the lumen was filled with pus, but sufficient details remained to show that both stems were of normal appendix structure and contained lymphoid tissue.

DISCUSSION

The causation of these duplications of the appendix has been discussed in several articles and various theories advanced to explain them.

On grounds of comparative anatomy, Mitchell (1905) postulated the persistence of paired avian cæca, and Jones (1912) suggested that the prommalian cæcum was a paired structure which led to obliteration of one cæcum in the greater specialization of mammals. Waugh (1941) considers this a feasible explanation of cases where the two appendices arise on either side of the ileocæcal valve, and classifies them as the 'bird' type.

Kelly and Hurdon (1905) observed a temporary outgrowth from the tip of the cæcum in the six-weeks-old embryo, and Gladstone and Wakeley (1924), who confirmed the observation, suggested that this is a completely independent structure which normally disappears before the permanent appendix differentiates. This appears to be a reasonable explanation of cases with two appendices arising from a single cæcum and it is accepted by Cave (1936). On this basis, partial duplicity would be produced by partial fusion of the two outgrowths.

Bremer (1944) suggested that congenital diverticula of bowel develop by persistence and development of minute epithelial buds, and duplications by faulty vacuolation of the solid cord of cells destined to form the alimentary tract. Though this is widely accepted as the possible cause of enterogenous cysts and ileal duplications (e.g., Wooler, 1949), its application to appendix duplex is obscure.

Ravitch's theory (1953) of caudal duplication has already been mentioned and it appears applicable to the major anomalies he describes. However, it does not appear so readily applicable to the other two varieties of appendix duplex.

Lastly, the idea that the condition is due to some disturbance in the organizer controlling the development of the appendix is strongly supported by Menten and Denny (1945), but this does not clarify the position to any great extent and remains merely a matter of hypothesis.

It seems impossible and perhaps unreasonable to try to relate all three varieties of appendix duplex to the one basic cause. Ravitch appears to present a reasonable explanation of duplicated cæcum and appendix, and Kelly and Hurdon (1905) of two appendices arising from one cæcum. The most satisfactory explanation of the many varieties of partial duplicity appears to be a matter for further discussion and argument.

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A CASE OF EOSINOPHILIC COLITIS

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A SPECIAL form of gastritis in which inflammatory œdema is accompanied by infiltration of all layers of the stomach wall by masses of eosinophils is now recognized under the name of 'eosinophilic gastritis' (Aird, 1957; Doniach and McKeown, 1951). Similar lesions have not, however, been reported in other parts of the alimentary tract and the following case may therefore be of interest. The patient had symptoms resembling those of acute appendicitis, which were subsequently found to be due to an acute eosinophilic inflammation of the cæcum and ascending colon.

CASE REPORT

A clerk, aged 17 years, had always enjoyed good health and at no time had suffered from any disease of allergic origin. He had never been abroad and there was no history of parasitic infestation. For about a year before his admission to hospital he had complained from time to time of vague abdominal discomfort associated with failure of appetite and some constipation. He was admitted on March 15, 1957 as an acute emergency, having complained of abdominal pain for 15 hours before his admission. The pain was situated across the lower abdomen and the patient vomited on one occasion. The pain was constant and not colicky and the bowels had been constipated. Micturition was normal. On examination the patient was rather pale but was well built; temperature 99°, pulse-rate 84. There was tenderness in the lower abdomen, particularly in the right iliac fossa, where there was a diffuse fullness. On rectal examination no abnormality was shown. He was kept under observation for a period of 12 hours, during which time his general condition remained unchanged, but the diffuse fullness and tenderness in the right iliac fossa became more marked. A diagnosis of appendicitis was then made and operation performed.

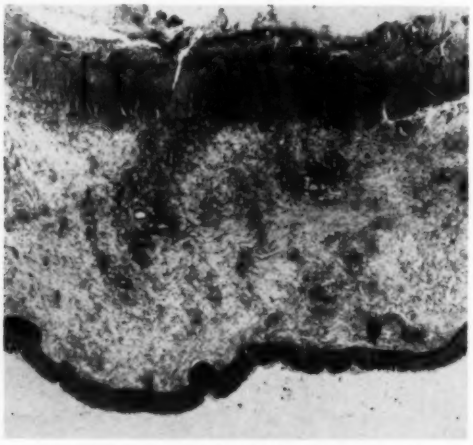

FIG. 533.—Low-power view showing the extensive œdema. The submucosa is swollen by œdema to three times the thickness of the muscular layer. H. and E. (× 6·6.)

AT OPERATION.—The abdomen was opened through a right-sided gridiron incision. Exploration showed no disease in the appendix but revealed a grossly œdematous cæcum. In view of the limited access a right paramedian incision was made so that the entire right colon could be fully examined. This showed that the whole cæcum and ascending colon were grossly thickened and œdematous, although in all but one small area the colour of the organ was normal. This small area was on the anterior wall of the cæcum about 1 × 2 cm. in extent and had a yellowish-white coloration. The serosa overlying it showed a peculiar transverse fissuring. The lymph-nodes draining the cæcum and the ascending colon were grossly enlarged. The findings in the right colon were so unusual that the diagnosis was by no means clear. The question of whether the patient was suffering from polyarteritis nodosa, or even from an unusual type of regional ileitis extending into the cæcum, was considered and in view of this a right colectomy was performed. During the mobilization of the cæcum and the ascending colon it was noted that the connective-tissue layers between the gut and the posterior abdominal wall were distended with brownish fluid. After the establishment of continuity of the bowel by end-to-end anastomosis between the terminal ileum and the transverse colon the wound was closed with drainage established down to the retrocolic space.

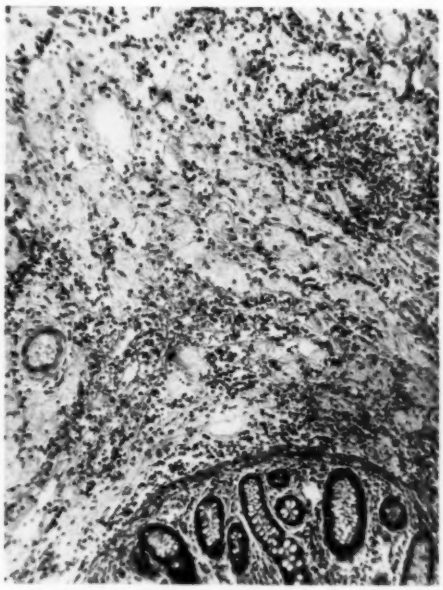

FIG. 534.—The submucosa showing that in addition to œdema there is a considerable infiltration by inflammatory cells. All these cells are eosinophils. H. and E. (× 60.)

POST-OPERATIVE PROGRESS.—Following operation the patient made an uninterrupted recovery and during this period further investigations were carried out. In view of the possibility of polyarteritis nodosa the patient's urine

was examined on four separate occasions. Apart from the finding of an occasional leucocyte and red corpuscle the urine was normal. Blood examination showed Hb 109 per

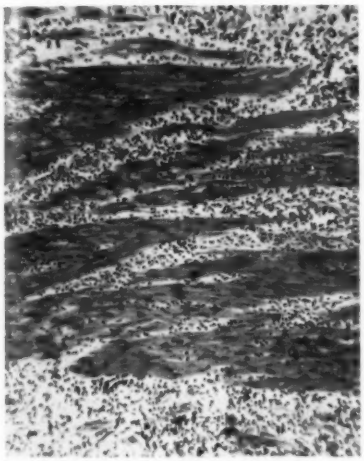

FIG. 535.—Eosinophils infiltrating the fibres of the muscular layer (*see also Fig.* 537). H. and E. (× 65.)

cent, W.B.C. 10,600, Polymorphs 74 per cent, Lymphocytes 11 per cent, Monocytes 14 per cent, Eosinophils 1 per cent, E.S.R. 4 mm. in 1 hr. Stools were examined for ova and cysts but none were detected and white counts

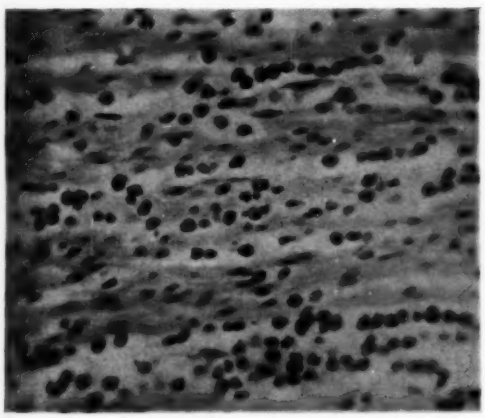

FIG. 537.—High-power view of a portion of the area of *Fig.* 535, showing the eosinophils. Lendrum's eosinophil stain. (× 525.)

carried out on a number of occasions never showed an eosinophilia. Nine months after the operation the patient was well and there had been no recurrence of his symptoms.

PATHOLOGY.—Examination of the specimen in the laboratory confirmed the observation made at operation that there was marked œdema of the cæcum and first part of the ascending colon. This œdema was maximal at the level of the ileocæcal valve and extended upwards along the ascending colon for a further 6 cm. The small intestine was normal, but there were a number of enlarged and congested lymph-glands in the mesentery in the vicinity of the ileocæcal valve. The œdema particularly affected submucosa which in places was twice to three times the thickness of the muscular layer.

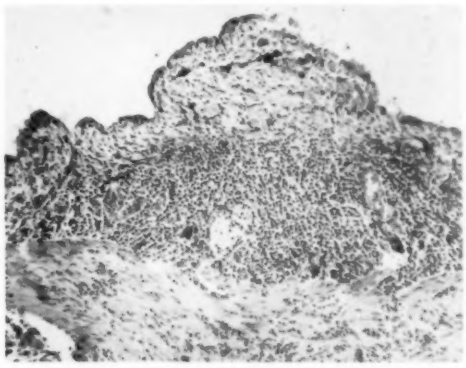

FIG. 536.—A focal collection of eosinophils in the subserosa separating the serous coat from the muscle (*see also Fig.* 538). H. and E. (× 65.)

Microscopical examination of sections (*Figs.* 533–538) showed that in addition to œdema there was a very considerable collection of inflammatory cells which consisted almost entirely of eosinophils. Masses of eosinophils occurred in the submucosa and were interspersed between the fibres in the muscular layer. Focal collections of eosinophils in the subserosa separated the serous coat from the muscle. There was no evidence of arteritis, and,

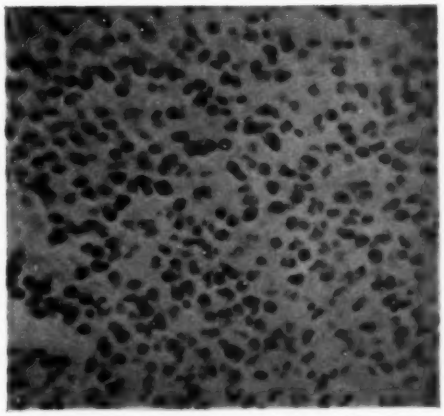

FIG. 538.—High-power view of portion of the area of *Fig.* 536, showing the eosinophils. Lendrum's eosinophil stain. (× 525.)

although there were considerable numbers of eosinophils in the region of the blood-vessels, the distribution of the eosinophils was general and not perivascular. Section taken from the inflamed mesenteric glands shows infiltration of the sinuses by large numbers of eosinophils.

DISCUSSION

The appearance of the gross specimen and of the section under the microscope seemed to bear a close resemblance to the published descriptions of the lesions in eosinophilic gastritis. This impression

was confirmed when an opportunity was obtained, through the courtesy of Dr. I. Doniach and Mr. K. C. McKeown, to make a direct comparison with the sections from their case of eosinophilic gastritis. Besides lending his sections, Dr. Doniach also most kindly examined sections from the present case; he considered that lesions in the two cases were almost identical.

A search of the literature has revealed only one reference to a condition similar to eosinophilic gastritis occurring elsewhere in the alimentary canal. Describing a case of eosinophilic gastritis Spencer, Comfort, and Dahlin (1950) state that it was their impression, at the operation, that the lesions may also have been present in the small and large intestine. Proof of this was lacking since sections for microscopical examination could only be taken from the resected stomach.

The aetiology of eosinophilic gastritis is discussed by Doniach and McKeown (1951). No firm conclusions were possible, but some form of allergy seemed to be the most likely cause. Apart from the site there was only one point of difference between the present case and eosinophilic gastritis: the absence of a blood eosinophilia. The difference does not seem to be an important one and, since no blood examination was made at the time, there may well have been a blood eosinophilia in the present case before operation. It seems probable therefore that the lesions in the present case were also allergic in origin; though, as in most of the cases of eosinophilic gastritis, a history of previous allergy was not obtained and there was no evidence of the presence of any of the recognized sensitizing agents.

SUMMARY

A case of eosinophilic inflammation of the cæcum and ascending colon is described. A comparison is made with eosinophilic gastritis.

I am most grateful to Mr. K. C. McKeown for advice and for permission to publish; to Dr. I. Doniach for the loan of slides and for his opinion on the sections in the present case; and to Dr. P. N. Coleman for help in interpreting the pathology. I also wish to thank Mr. S. Taylor, F.I.M.L.T., for preparing the section and the photomicrographs.

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A CASE OF DOUBLE PRIMARY CARCINOMAS OF THE ŒSOPHAGUS

BY A. KINGSLEY BROWN, M.B.E.

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THE occurrence of multiple independent growths in any organ is a rare phenomenon with the exception of polyposis of the colon and epidermal tumours of the skin. Wallace (1957) gives data on 134 patients out of 3006 suffering from malignant diseases who developed more than one primary neoplasm; Robinson and Jackson (1958) describe 9 cases of dual primary cancer of the lung and Callanan (1954) reported a case showing two tumours of the œsophagus of different structure, carcinoma and leiomyoma, but an extensive search of the literature has failed to find an example of two independent primary œsophageal carcinomas. The following case, which showed several unusual features, is considered of sufficient interest to record.

CASE REPORT

Clinical History.—Mr. J. B., aged 66 years, was admitted to hospital on March 26, 1955, complaining of dysphagia. In February, a month prior to his admission, he first noticed difficulty in swallowing meat. This disability rapidly progressed until he was unable to swallow any solid food, which appeared to stick at the mid-sternal level and was then regurgitated. He had no difficulty with semi-solids until a week before his admission, when he complained of difficulty in swallowing fluids. He said he had lost a stone in weight during the first three months of 1955, but otherwise had no complaints.

ON EXAMINATION.—Physical examination was not illuminating. His general condition was good, with no obvious emaciation or anæmia, hæmoglobin being 90 per cent. Apart from a blood-pressure of 190/90, no clinical signs were noted in the cardiovascular or respiratory systems and nothing abnormal was palpable within the abdomen. No enlarged lymph-nodes were found. Investigations included blood chemistry, a barium meal, and œsophagoscopy. Blood chemistry was within normal limits. A barium-meal examination by Dr. R. B. Boal showed by screening and films a persistent filling defect of the anterolateral wall of the œsophagus immediately below the aortic impression. It was considered to be a growth in direct contact with the aorta. A diverticulum was also noted 1 in. below the growth, arising from the anterolateral wall. The diverticulum emptied readily and was apparently symptomless. There appeared to be little delay of the barium cream at this level, but a persistent narrowing of the lower end of the œsophagus was observed about 2–3 in. from the cardia which caused a very considerable hold-up of the barium with severe peristalsis in the œsophagus. This filling defect was indistinguishable from a primary growth in the œsophagus (*Fig.* 539). Œsophagoscopy after the barium meal confirmed the presence of the upper growth, situated on the left wall 25 cm. from the incisor teeth, and almost occluding the lumen. It was not possible to get beyond this growth to the lower regions of the œsophagus. Biopsy tissue from the proximal lesion showed a squamous-cell carcinoma.

TREATMENT.—Although there was a proven carcinoma at 25 cm., there was some debate whether the filling defect in the lower third could be due to spasm despite the radiological appearances of carcinoma. Laparotomy followed by right thoracotomy was performed on March 31. At laparotomy no growth was felt at the cardia or lower

œsophagus and the cœliac lymph-nodes appeared normal. The stomach was mobilized and the abdomen closed. The right chest was then opened and the presence of two

FIG. 539.—Barium swallow showing the persistent filling defect of the upper growth with the diverticulum 1 in. below, and the typical 'rat-tail' deformity of the lower growth.

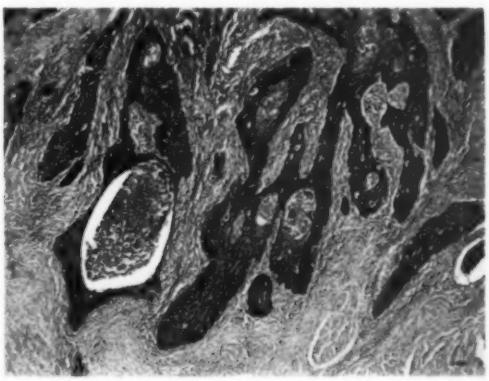
A

FIG. 541.—A, The upper malignant area with two nodular carcinomas and the early intervening one. (× 3/5.) B, To show infiltration of the muscle wall in the larger upper tumour at b in A. (× 26.)

tumours confirmed, one situated just below the aortic arch, the other 3 in. above the crus. The œsophagus was mobilized and divided 2 in. above the upper growth. The remaining portion of the œsophagus and the upper third of the stomach were then resected (*Fig.* 540) and a gastro-œsophageal anastomosis was performed at the level of T.4. A mediastinal lymph-node was removed for examination. The chest was closed in routine fashion, the pleural sac being drained.

PATHOLOGY.—*The upper tumour area* presented two closely approximated nodular growths (*Fig.* 540). Both were ulcerated, the larger showing discoloration from superficial hæmorrhage, possibly due to biopsy. Transection confirmed the presence of two malignant tumours with a narrow intervening zone of thickened epidermis (*Fig.* 541 a). Microscopical examination showed both tumours to be squamous carcinomas, partly papillary in structure and without keratinization or 'pearl' formation. Mitotic figures were moderately numerous. The smaller carcinoma (a) was limited to the submucosal zone; the larger (b) showed tumour infiltration of the whole thickness of the muscle wall (*Fig.* 541 b). Both areas showed much acute and chronic inflammatory-cell infiltration, evident in the larger tumour as scattered micro-abscesses. The intervening thickened epidermis was also a squamous

FIG. 540.—The excised œsophagus and cardiac end of stomach to show the two upper nodular tumours and the lower non-papillary growth with marked stenosis.



B

carcinoma at a very early stage of invasion. No tumour deposits in lymph- or blood-vessels were identified.

The lower tumour area, examined in two planes at right angles, was also a squamous carcinoma but of somewhat different type. The ulcerated tumour showed no papillary structure but a flattened surface with cellular downgrowth as large masses of poorly differentiated cells (*Fig.* 542). There was some 'pearl' formation in the deeper areas and the strands and masses of malignant cells showed numerous atypical forms with monstrous nuclei and many mitotic

figures. The tumour had grown through all the muscle layers (*Fig.* 543). As in the upper malignant zone, no invaded lymph- or blood-vessels could be identified.

The intervening "normal" mucosa: Sections were prepared from three equidistant horizontal levels between the upper and lower malignant areas (*Fig.* 540). They included the whole thickness of the œsophageal wall. No evidence of malignant change in the mucosa or of the

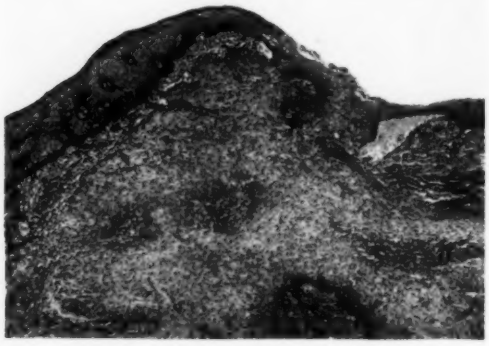


FIG. 542.—The lower tumour, showing origin from a non-papillary surface and cellular downgrowth. (× 26.)

transport of tumour cells in lymph- or blood-vessels was found in any of the fields examined.

Both upper and lower carcinomas are regarded as independent primary growths: (1) All showed the characteristic multifocal mode of origin of epidermal carcinomas; (2) they differed in the presence or absence of papillary structure; and (3) the intervening tissue showed no evidence of embolic or continuous transport of malignant cells.

PROGRESS.—Convalescence was in the main uneventful, except for a rupture of the abdominal wound on the sixth post-operative day. Apart from this he made an uninterrupted recovery and was discharged 24 days after operation. He has been seen in the follow-up clinic on four occasions and found to be well, eating a normal diet, and working full time. There were no clinical signs of metastases and a barium meal showed a well-functioning anastomosis.

SUMMARY

A rare case of double primary carcinomas of the œsophagus is presented. It is of interest in that:—

a. The patient gave a relatively short history of only two symptoms—namely, dysphagia and loss of weight.

b. The diagnosis of the probability of two growths was made pre-operatively.

c. The condition progressed very rapidly.

d. The pathology, as confirmed by microscopy of multiple sections of the specimen, showed the presence of two primary tumours in the œsophagus, both squamous carcinomas, partly papillary in structure and without keratinization or 'pearl' formation, the intervening tissue being free of malignant cells.

FIG. 543.—The lower tumour with masses of malignant cells infiltrating the muscle wall and much chronic inflammatory reaction. (× 26.)

I must extend by most grateful thanks to Mr. E. F. Chin for permission to publish this case; and to Mrs. E. K. Dawson, Pathologist to the University of Edinburgh, for her kind help and assistance in the micropathology; also to the Photomicrography Unit of the Department of Pathology in the University of Edinburgh for *Figs.* 541–543.

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SMALL-BOWEL OBSTRUCTION FOLLOWING PARTIAL GASTRECTOMY

BY PETER R. KNIGHT AND DAVID E. BOLT
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INTESTINAL obstruction due to herniation of a loop of small bowel through the hiatus between the anastomosis and the transverse colon, following partial gastrectomy with a Polya type of reconstruction, was first described by Stammers in 1952. Since then Oldham (1953) and West (1953) have also reported instances of this complication, while in 1954 Stammers collected together his own cases, those in the literature, and others reported to him personally, to present the condition as a definite clinical entity. The present case is of interest as an addition to the literature of the subject because it happened a longer time after gastrectomy than any previously reported case, while it also involved not a single loop of small bowel, but almost the whole small intestine distal to the anastomosis.

CASE REPORT

The patient, a man aged 52 years, was admitted to hospital as an emergency on May 26, 1957. He gave a history of five hours' severe intermittent abdominal pain, suggesting small-bowel colic, accompanied by three episodes of vomiting of food and bile-stained fluid. He had had a normal bowel action that morning and had passed a little flatus since the onset of the pain. He had no other relevant symptoms.

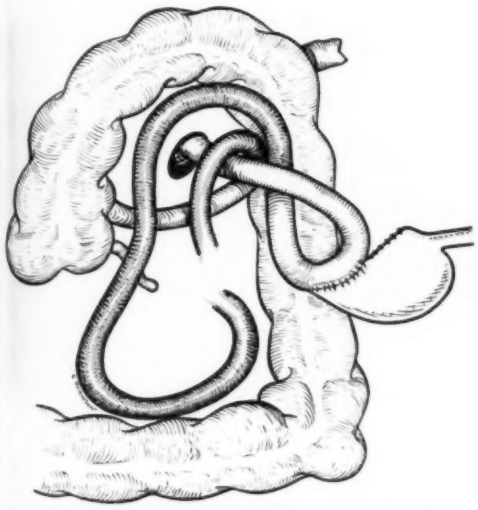

FIG. 544.—Line drawing showing the situation found at operation. For the sake of clarity the amount of small bowel involved in the herniation has been greatly reduced, and is shown interrupted.

The patient had had two previous operations. In February, 1950, he had been operated on for a volvulus of the cæcum, which proved to be viable and to lie in the left hypochondrium. The volvulus was relieved and the cæcum and ascending colon sutured to the anterior abdominal wall, convalescence being complicated by a fæcal fistula. Unfortunately this detailed information was not available at the time of his present admission. In November, 1950, the patient underwent a partial gastrectomy, at another hospital, for a benign gastric ulcer, the reconstruction being antecolic, with afferent loop to lesser curve and with a small valve (Finsterer-Hoffmeister). The afferent loop was about 6 in. long.

ON EXAMINATION.—The patient appeared somewhat shocked, his face was pale and his blood-pressure 105/70. He was having severe attacks of colic at 5-min. intervals, felt diffusely over the abdomen. The scars of epigastric midline and lower right paramedian incisions were visible, but there was no tenderness, guarding, or palpable tumour. The gut sounds were typically obstructive. There was no abnormality on rectal examination.

AT OPERATION.—After minimal preparation, laparotomy was undertaken with the pre-operative diagnosis of acute small-bowel obstruction, probably due to a band. The right paramedian incision was re-opened with difficulty, the cæcum being found adherent to it, in an unusually high and medial position. All the visible small bowel was found to be collapsed and blue in colour and it took some time to realize that almost the whole small bowel had passed from left to right through the hiatus behind the antecolic anastomosis, leaving a short length of terminal ileum leading down to the abnormally placed cæcum (*Fig.* 544). Although the herniation was easily reduced, the bowel remained blue until about two-thirds had been drawn back through the hiatus, when the whole bowel suddenly became pink. The vascular obstruction appeared to be produced by twisting of the small-bowel mesentery, and there was no interference with the blood-supply of the afferent loop. The abdomen was closed as soon as reduction was complete and viability assured, and the patient had an uneventful convalescence.

COMMENT

Having studied the literature since, it is apparent that to prevent a recurrence of the same obstruction one should have closed the space behind the anastomosis and in front of the colon. This is also the lesson to be learnt when performing partial gastrectomy with an antecolic anastomosis. Unfortunately this was not done.

In all but three previously reported cases, the herniation of small bowel through the retrostomal hiatus took place during convalescence. The longest previously reported interval after gastrectomy was 2½ years, but in the present case the delay was 6½ years, suggesting that this type of complication remains a possibility indefinitely. In the great majority of previously reported cases the small bowel passed from right to left behind the stoma, but the cases illustrated by *Figs.* 29, 30 in Stammers's paper (1954) both bear some resemblance to the present case in this report. Neither, however, involved so large a section of the small intestine, while that illustrated in Stammers's *Fig.* 30 arose following a Moynihan-type of reconstruction. The exceptionally complete herniation of the small bowel in the case described probably resulted from the abnormal position and the fixation of the cæcum and lower ileum.

SUMMARY

A case of small-bowel obstruction due to herniation through the retrostomal space left after partial gastrectomy is described. The exceptionally long interval after gastrectomy is noted and the unusual amount of small bowel involved is attributed to abnormal fixation of the cæcum.

Our thanks are due to Mr. W. J. Ferguson, under whose care the patient was admitted, for permission to publish this account; and to Professor F. A. R. Stammers for his interest and encouragement.

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TRAUMATIC DIAPHRAGMATIC HERNIA WITH STRANGULATION AND GANGRENE OF THE STOMACH

BY C. N. ALIVISATOS, M. SARRIS, G. AVLAMIS, N. TSIVOGLOU, AND N. DROSSOS
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POST-TRAUMATIC diaphragmatic herniæ may be followed by several complications due to visceral strangulation at the site of the trauma. Of these strangulation and volvulus of the stomach through the diaphragmatic gap are relatively the most severe.

Stuart W. Harrington (1948), in a study of the various types of post-traumatic diaphragmatic hernia in a series of 430 cases, reports 6 cases of perforated gastric ulcers following the compression exerted on the stomach protruding through the diaphragmatic gap, but not a single case of gastric necrosis.

In 1948 Dugan and Samson published 2 cases of traumatic diaphragmatic hernia with strangulation and gangrene especially of the stomach, and in 1949 Hamilton and Phillips cited 2 other cases. Hoffman communicated a case in 1954 and recently Jount (1956) an additional one, so that in a review of the available literature on the subject the number of similar reported cases is found to be 12.

In the Hellenic literature up to the present 10 cases of traumatic diaphragmatic hernia have been reported with strangulation of various viscera (spleen, large bowel, small intestine, stomach, etc.), but in none of them is an association of strangulation with gangrene or perforation of the stomach mentioned (Varlamidis, 1937; Karayannopoulos, cited by Spyridonos, 1952; Karayannopoulos and Bataimis, 1929; Kotsonopoulos, 1923; Makkas, 1923, 1948; Palios, cited by Spyridonos, 1952 ; Kokkalis, 1941).

The rarity of total or local ischæmic necrosis of the strangulated stomach protruding through the diaphragmatic gap is attributed to the rich vascularity and elasticity of its wall in contradistinction to the large and small intestines which are more frequently the site of strangulations and resulting ischæmic necrosis.

According to Carter and Giuseffi (1948) strangulation of the stomach may occur on the same day as the trauma, but it has been observed as much as sixteen years later. In most cases (85 per cent) reported by these authors, however, strangulation of the stomach through the gap of post-traumatic diaphragmatic hernia occurred within three years. In addition they state that strangulation is the most frequent complication of traumatic diaphragmatic hernia, occurring in over 90 per cent of cases.

Post-traumatic diaphragmatic herniæ occur ordinarily on the left side, and in 430 cases of different types reported by Harrington (1948) 98·4 per cent were left-sided.

The viscus commonly strangulated in traumatic diaphragmatic hernia is the stomach. If the gap in the diaphragm is large, the displacement of the great curvature into the chest is observed, as this represents the most movable portion of the stomach (Morisson, 1923). The stomach thus displaced may then twist on its transverse axis, giving rise to the acute symptomatology of volvulus in the left chest, as was noticed in our personal case.

An emergency case was recently admitted to the Surgical clinic of the 'Hippocrateion' Hospital, being a 17-year-old young man, severely injured with a knife thirteen days prior to his admission, the site of the trauma being at the base of the left chest.

This resulted in injury to the diaphragm, with consequent strangulated diaphragmatic hernia and volvulus of the stomach.

Along the lesser curvature the stomach showed extensive necrosis with perforation and the formation of a thoraco-abdominal abscess.

The report of our case is briefly given:

CASE REPORT

Patient, male, 17 years old, admitted as an emergency case.

Present illness: Thirteen days prior to his admission the patient was injured with a carving knife during a quarrel. Penetration occurred in the posterior axillary line at the level of the 7th intercostal space.

The patient was transferred from the village where he was injured to the city of Chalchis and was nursed in a surgical clinic of that town. A simple suture of the wound was there carried out. Two hours after his injury the patient suddenly experienced a stabbing pain on the left side of the chest, with dyspnœa, cyanosis, and tachycardia. The subcutaneous emphysema resulting from the injury rapidly involved the whole left chest.

During the first four days the patient, apart from dyspnœa and cyanosis, suffered from repeated hæmatemeses, especially following every attempt to take food, thus rendering his alimentation almost impossible.

Slowly the vomiting became less and the patient began to take light and digestible food, only dyspnœa of mild degree persisting.

The patient remained in good condition until suddenly he had a profuse hæmatemesis amounting to about 300 c.c. of pure blood. On Feb. 13, 1957, owing to the seriousness of his state he was transferred as an emergency to the Hippocrateion Hospital. The temperature was 36·8° C., the pulse 120 per min., and the respiration 40 per min. *Family and personal history* irrelevant.

ON ADMISSION.—The patient showed the facies of a seriously ill person with dyspnœa, mild cyanosis, and tachycardia.

SYSTEMIC EXAMINATION.—The inspection of the chest revealed a 2-cm. stab-wound scar of a recent injury on the left side of the chest at the level of the seventh intercostal space in the posterior axillary line. Heart-beats were perceptible at the right border of the sternum.

Respiratory System: Percussion revealed dullness at the base of the left hemithorax. On auscultation, respiratory silence was present all over the area of the left chest.

Circulatory System: Main focus of auscultation of the heart in the fourth intercostal space parasternally, with heart-beat evident at this area.

Alimentary System: The patient rejected immediately all food, fluid or solid.

X-RAY EXAMINATION (*Figs.* 545–548).—Radioscopy and chest films showed that: (1) The fundus of the

stomach reached the level of the third rib and its dimensions were increased; (2) The left lung was retracted towards the left hilum, and contracted to the size of a fist; (3) Presence of pneumothorax; (4) The heart shadow was displaced to the right; (5) Absence of paradoxical diaphragmatic motility. Following barium administration the opaque medium was seen to pass very slowly through the cardia. When the patient was placed in the Trendelenburg position, the major part of the stomach

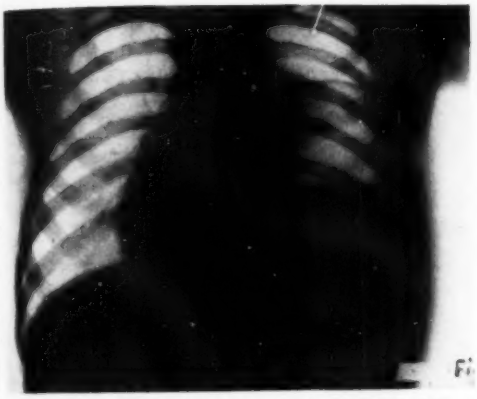

FIG. 545.—The fundus of the stomach at the level of the third rib. Left lung, the size of a fist, retracted towards the hilum. Pneumothorax is present. Displacement of the heart shadow to the right.

FIG. 547.—Slow passage of the opaque medium through the cardia. The volvulus of the stomach is seen.

was found in the left side of the chest and had to be inverted. The limits of the diaphragmatic dome could not be fixed. (*Figs.* 545–548.)

A chest aspiration was not carried out.

The conclusion drawn from the X-ray examination was traumatic diaphragmatic hernia with possible strangulation of the stomach. Operation was obviously indicated.

AT OPERATION.—High œsophagogastrectomy, œsophago-pyloric anastomosis according to Sweet's technique suture of the diaphragm.

Left thoracotomy along the seventh rib. Partial stripping of its periosteum and resection of a part of the rib at its posterior angle. Following the opening of the pleura, one observed:—

FIG. 546.—Chest radiograph in oblique view, the fundus at the level of the third rib.

FIG. 548.—Radiographic examination of the stomach in Trendelenburg position. Its greater portion is found in the left hemithorax.

1. A large part of the fundus of the stomach was present in the left side of the chest. This part was swollen, red, and covered with pseudomembranes.

2. A 10-cm. long gap in the left diaphragmatic dome and stomach protruding through it.

3. The left lung was retracted towards the hilum, reduced to the size of a double fist.

4. The left side of the chest was filled with serosanguineous fluid. The part of the stomach found in the chest was adherent to the anterior mediastinum. In the presence of this complicated condition we proceeded to

correct the condition. The left lung was freed and almost entirely expanded: it was then pushed upwards. The post-traumatic aperture in the left diaphragm was examined. The stomach was found adherent to the edges of the diaphragmatic gap and was freed. An unsuccessful attempt to reduce the stomach into the abdominal cavity was then made. During this attempt an abscess cavity was opened containing fœtid pus which had collected around the *hiatus œsophageus*. The posterior part of this abscess was bounded by the œsophagus, aorta, and the pericardium and protruded in a 'water-clock'-like manner through the *hiatus œsophageus*, under the diaphragm, and into the abdominal cavity. We were

FIG. 549.—Chest radiograph in frontal view. Restoration to the normal. Complete expansion of both lungs. Heart shadow at its normal position.

compelled to divide the diaphragm through the *hiatus œsophageus* and drain the abscess. At the level of the cardia the stomach showed a rotation of about 90°; this twisting resulted in a widespread necrosis of the gastric wall which did not permit simple suture. The thoraco-abdominal abscess formed around the volvulus resulted from the necrosis of the stomach, and consequently we were compelled to perform a total gastrectomy after having preserved a small pyloric stump.

By an appropriate mobilization of the distal portion of the œsophagus and the pyloric stump we succeeded in performing a fairly satisfactory anastomosis in three layers. The gap edges in the left diaphragmatic dome were trimmed and a 'frock-coat'-like suture was effected. Additional U-like sutures were applied.

Expansion of the lung was effected and closure of the thoracic wound, which in the meantime had been extended on the anterior abdominal wall down to the umbilicus, carried out. Drainage of the left chest. Complete closure of the remaining wound.

Post-operative Course.—The post-operative course was uneventful. The X-ray examination carried out a fortnight after the operation showed that: (1) Both lungs were fully expanded; the diaphragm moving normally and the heart shadow occupying its normal site (*Fig.* 549). (2) The barium passage from the œsophagus to the gastric stump (pylorus) was carried out slowly and normally, whereas the X-ray examination in Trendelenburg position revealed regurgitation of the opaque medium (*Figs.* 549, 550).

The patient was discharged on March 30, 1957, in good health. A further X-ray examination four months after the operation in connexion with the patient's subjective complaints (slight burning sensation on swallowing food, sometimes acid belching) showed an œsophagitis of slight degree due to partial regurgitation of the pyloric contents.

The patient's complaints were relieved by strict observation of an appropriate diet. Gastric juice examination showed a lack of acidity prior to or after histamine

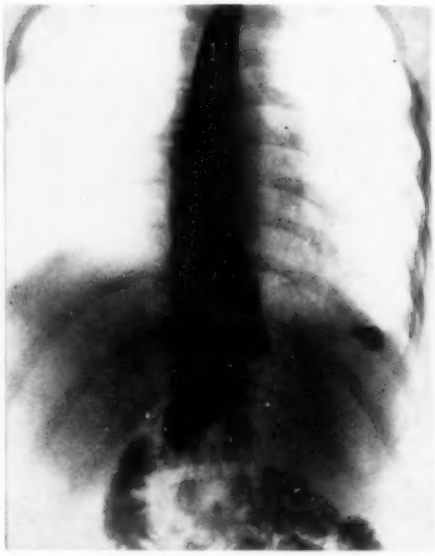

FIG. 550.—Four months after operation. Restored continuity of the alimentary tract (œsophagus-pylorus). Radiologically, in Trendelenburg position, regurgitation of a small amount of opaque medium is seen.

administration. In fact, this juice was rather alkaline; the symptoms of mild œsophagitis of which the patient complained were due to a regurgitation of fluid of alkaline reaction.

DISCUSSION

The appearances on the original radiographs suggested features of a traumatic diaphragmatic hernia with strangulation of the stomach such as Carter and Giuseffi (1948), Hamilton and Phillips (1949), Hoffman (1954) state are pathognomonic of this condition.

The œsophagogastrectomy was performed by a thoraco-abdominal approach and the continuity of the alimentary tract was restored by an anastomosis of the œsophagus to the pylorus. The post-operative course was uneventful. Œsophagitis of mild degree observed four months after the operation is an ordinary late complication in this type of operation.

The same operation of œsophagogastrectomy had been carried out in 2 out of 12 similar reported cases of traumatic diaphragmatic herniæ with strangulation and perforation of the stomach. In a case published by Hamilton and Phillips (1949) the patient was operated upon two months after a car accident; at the operation, the presence of a strangulated

traumatic diaphragmatic hernia with necrosis of the fundus of the stomach was found. The operation consisted in resection of the fundus and restoration of the continuity by anastomosing the œsophagus to the body of the stomach.

The second case was reported by Jount (1956). This was an emergency case operated upon for symptoms suggesting high ileus. The gastric necrosis involving the fundus following a strangulated traumatic diaphragmatic hernia was confirmed at operation and removal of the greater portion of the stomach (fundus + body) and the anastomosis of the œsophagus to the pyloric antrum were carried out in this case.

We feel therefore the correctness of Hoffman's opinion (1954), as well as that of many other authors, according to which the presence of an unusual and unexplained pain experienced at the base of the left chest or the upper part of a patient's abdomen with a history of recent or previous severe trauma demands the most serious consideration, the above symptomatology directing the surgeon's attention to the possibility of a traumatic diaphragmatic hernia in which a portion of the stomach may possibly be involved.

The exact weighing of the associated clinical and laboratory findings will contribute to confirm the diagnosis.

The principal findings as reported by most authors (Carter and Giuseffi, 1948; Hamilton and Phillips, 1949; Fffler, 1950) are: (1) History of severe trauma probably involving the diaphragm; (2) Stabbing pain localized at the superior left side of the abdomen (left hypochondrium) and the left chest, radiating sometimes to the left shoulder; (3) Repeated vomiting (this symptom was observed in the majority of the cases); (4) Respiratory embarrassment reaching sometimes pronounced dyspnœa (common symptom in different types of diaphragmatic hernia); (5) Displacement of the mediastinum to the right and consequently heart-beat perceptible at the right border of the sternum. (6) Flatness or tympany at the lower part of the left side of the chest (owing to the intrathoracic protrusion of a part of the stomach); (7) Bloody or serosanguineous fluid, present in the left side of the chest; and, finally (8) Radiological findings such as fluid present in the chest, left hemidiaphragm elevated, portion of the stomach present in the left side of the chest (seen on screening following barium administration). The radiological investigation is the most important and its findings are of great value in the diagnosis of the condition.

CONCLUSIONS

1. Traumatic diaphragmatic hernia followed by strangulation and gangrene of the stomach is a rare condition. Sudden pain in the lower chest or the upper abdomen in individuals with a history of severe trauma (chest or abdomen) should draw the attention to the possible presence of this complication.

2. Early diagnosis is of great importance to permit a timely decision as to surgical treatment to be made.

3. The type of surgical procedure depends on the lesions present. When the necrosis of the stomach involves an extended area, the removal of the upper portion of this organ is necessary; in our patient we were compelled to perform a large œsophagogastrectomy, with anastomosis of the thoracic portion of the œsophagus to the pylorus according to Sweet's technique.

4. The thoraco-abdominal route furnishes the best approach in such circumstances.

5. From a review of the available literature only in 2 out of the 12 recorded cases was this large removal performed on account of strangulation of the stomach following a post-traumatic diaphragmatic hernia.

6. The immediate result of this surgical procedure in our case was satisfactory, although four months after the operation symptoms of œsophagitis were observable owing to partial regurgitation of duodenal contents in the lower portion of the œsophagus.

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INTUSSUSCEPTION IN INFANCY AND CHILDHOOD

A REVIEW OF 400 CASES

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INTUSSUSCEPTION ranks high in importance as an acute surgical catastrophe in infancy and early childhood. This paper is a review of 400 consecutive patients who underwent operation for intussusception in one surgical unit at the Royal Hospital for Sick Children, Glasgow, from 1946 to 1957. The period covered by the review begins directly after the War and coincides with a time of great advances in anæsthesia and in pre- and post-operative treatment.

When the diagnosis of intussusception is made early, and when treatment is promptly and efficiently given, the results are good. When diagnosis and treatment are delayed the prognosis becomes much worse, although it is not so grave as it was in the past. In *Table I* and *Fig.* 551 the patients are grouped according to the duration of their symptoms before operation. There is a steady rise in the mortality-rate after 24 hr., the peak being reached at 72 hr. After 72 hr. the mortality-rate falls. This is at first surprising but is explained by the fact that the group of 73 hr. and over, which consists of 14 per cent of all the patients, includes a number in whom the intussusception was of a subacute type, spontaneously reducing and recurring over a period of several days. Since 1951 there have been no deaths in 145 patients whose symptoms were of 24-hr. duration or less. *Table I* also shows that the likelihood of irreducibility usually increases with the duration of symptoms. The curve of the mortality-rate almost exactly parallels that for irreducibility.

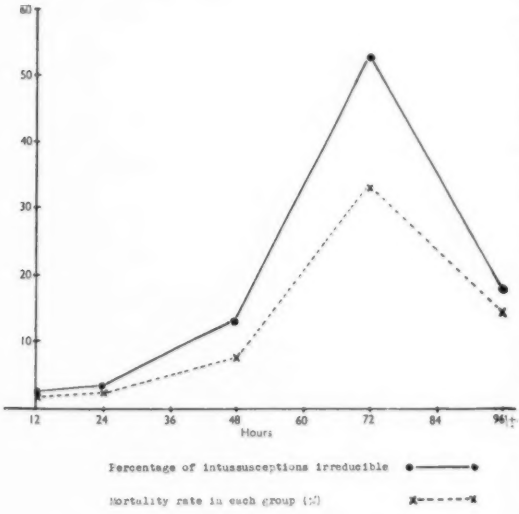

FIG. 551.—This graph correlates the duration of symptoms, the percentage of intussusceptions found irreducible at operation, and the mortality-rate in each group.

Table II and *Fig.* 552 show the mortality-rate in each year, the percentage of intussusceptions found to be irreducible at operation, and the average duration of symptoms in hours before operation. The figures for duration of symptoms refer only to *acute* intussusceptions. The average duration is 30 hr. It is interesting that the average figure for males was 28·5 hr., while that for females was 32·5 hr. This average duration of symptoms of 30 hr. is very little less than the figure of 32 hr. given by Perrin and Lindsay (1921) in their English series almost forty years ago. It is a great deal larger than the Australian figure of 16 hr. quoted in Hipsley's paper of 1926. It is, however, the same as the figure given by Gross (1953) in an American series. *Fig.* 552 shows a rough parallel between the average duration of symptoms in each year and the percentage of intussusceptions found to be irreducible at operation. The mortality-rate has undergone a great reduction through the years, even though there is still too great a delay in diagnosis.

Table I.—DURATION OF SYMPTOMS IN 400 PATIENTS RELATED TO IRREDUCIBILITY AND MORTALITY-RATE

	Duration of Symptoms (Hours)						Total
	0–12	13–24	25–48	49–72	73+	Time Unspecified	
No. of patients	169	95	57	15	57	7	400
No. irreducible at operation	4	3	7	8	11	0	33
Percentage irreducible	2·4	3·2	12·3	53·3	19·3	0	8·25
No. of deaths	3	2	4	5	9	0	23
Mortality-rate in each group (per cent)	1·8	2·1	7·0	33·3	15·8	0	5·75

AETIOLOGY

In adults intussusception is commonly caused by a demonstrable pathological lesion, usually a simple

or malignant tumour of the bowel. In infants and young children, however, it is only rarely that such a causative lesion is found. In the present series the following lesions were encountered:—

Meckel's diverticulum forming apex of intussusception, 5 patients (aged 5 months, 15 months, 17 months, 22 months, and 4 years).

Adenoma of small bowel, 1 patient (aged 9 years).

Henoch-Schönlein purpura, 2 patients (both aged 6 years).

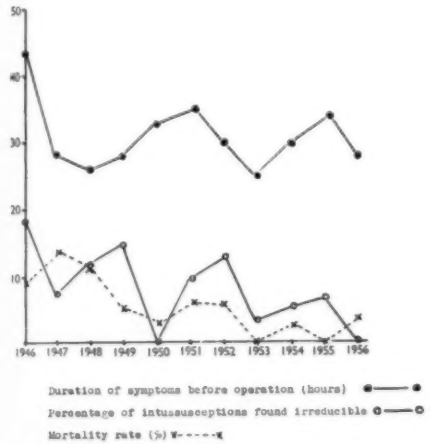

FIG. 552.—A graph showing, for each year, the average duration of symptoms before operation (exclusive of subacute cases), the percentage of intussusceptions irreducible, and the mortality-rate.

Thus, a definite cause was found in only 8 patients (2 per cent of the series), leaving the great majority unexplained. Small multiple intussusceptions are sometimes observed fortuitously at laparotomy in children. Only an inch or so of intestine is affected at each place and the apex appears to be a part of the intestine which is in spasm and has been gripped by the part beyond. It is possible that small intussusceptions, which spontaneously occur and reduce in this manner, are frequently being formed during peristalsis, and that only when spontaneous reduction does not occur does the condition become clinically apparent.

Although no definite explanation can be given for the occurrence of intussusception, the following observations have been made in this series.

1. The age-group most commonly affected is between the third and tenth months (*Table III*, *Figs.* 553, 554). This is a period when the infant is undergoing alterations in his diet. A more solid diet may perhaps induce more vigorous peristalsis.

2. Boys are more often afflicted than girls. In this series there were 250 boys (62·5 per cent) and 150 girls (37·5 per cent). The reason for the difference in incidence in the two sexes is not clear. It is curious that the mortality-rate for boys was 4·8 per cent while that for girls was 7·3 per cent (*Table IV*). This higher mortality for the girls may be due to the greater delay in diagnosis noted above.

3. The intussusception was preceded by enteritis in 18 patients (4·5 per cent).

4. The mesenteric lymph-nodes are usually very obvious at laparotomy in cases of intussusception; indeed, in many patients the nodes are quite fleshy and inflamed. A special note of the condition of the mesenteric nodes was taken in 318 of the patients:—

In 89 patients (27 per cent) there was a mild but definite degree of mesenteric lymphadenitis.

In 52 patients (16 per cent) there was mesenteric lymphadenitis of moderate severity.

In 11 patients (3·5 per cent) the nodes were grossly enlarged and were present in large numbers, constituting a severe degree of mesenteric lymphadenitis.

It is reasonable to suppose that the condition of the mesenteric nodes reflects that of the lymphoid tissue in the wall of the intestine. After reduction of an intussusception it is usually possible to demonstrate a thickened ring of lymphoid tissue in the region of

Table II.—NUMBER OF PATIENTS ADMITTED EACH YEAR, SHOWING AVERAGE DURATION OF SYMPTOMS (IN ACUTE CASES), NUMBER IRREDUCIBLE, AND MORTALITY-RATE

	YEAR												TOTAL
	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957*	
No. admitted	33	43	33	40	29	31	32	59	38	31	25	6	400
Average duration of symptoms before operation (hr.)	44	28	26	28	33	35	30	25	30	34	28	—	—
No. reducible	27	40	29	34	29	28	28	57	36	29	25	5	367
No. irreducible	6	3	4	6	0	3	4	2	2	2	0	1	33
Deaths among those reduced	2	2	2	0	1	1	0	0	0	0	1	0	9
Percentage irreducible	18·1	7·0	12·1	15·0	0·0	9·7	12·5	3·4	5·3	6·5	0·0	—	8·25
Deaths in irreducible cases	1	3	2	2	0	1	2	0	1	0	0	1	13
Total deaths	3	6†	4	2	1	2	2	0	1	0	1	1	23
Mortality-rate (per cent)	9·0	14·0	12·1	5·0	3·4	6·4	6·2	0·0	2·6	0·0	4·0	—	5·7

* The 6 patients in 1957 were admitted in the first quarter of the year.
† One patient moribund on admission—no operation performed.

the ileocæcal valve. Such an area of lymphoid hyperplasia might easily form the starting point of an intussusception (Perrin and Lindsay, 1921). Recent work suggests that the inflammation of the mesenteric lymph-nodes and associated lymphoid tissue may be of viral origin. Rowe, Huebner, Gilmore, Parrott, and Ward (1953) originally demonstrated a group of viruses in tissue fragments of tonsils and adenoids. These they called the 'adenoidal-pharyngeal-conjunctival (A.P.C.) group'. These viruses have been recovered from mouth-washings, conjunctival secretions, and fæces. Antibodies against one

Table III.—Age Distribution of all Patients

Age	*No. of Patients*	*Male*	*Female*
Under 1 mth.	2*	2	—
1– 2 mth.	4	3	1
2– 3 mth.	12	5	7
3– 4 mth.	32	21	11
4– 5 mth.	54	26	28
5– 6 mth.	34	21	13
6– 7 mth.	44	29	15
7– 8 mth.	21	15	6
8– 9 mth.	15	10	5
9–10 mth.	15	8	7
10–11 mth.	12	7	5
11–12 mth.	5	1	4
12–13 mth.	9	5	4
13–14 mth.	6	4	2
14–15 mth.	5	4	1
15–16 mth.	5	4	1
16–17 mth.	3	2	1
17–18 mth.	4	3	1
18–19 mth.	4	4	—
19–20 mth.	3	2	1
20–21 mth.	1	—	1
21–22 mth.	4	4	—
22–23 mth.	4	1	3
23–24 mth.	4	3	1
2– 3 yr.	38	29	9
3– 4 yr.	24	16	8
4– 5 yr.	12	6	6
5– 6 yr.	9	4	5
6– 7 yr.	7	6	1
7– 8 yr.	5	5	—
8– 9 yr.	1	—	1
9–10 yr.	1	—	1
10–11 yr.	1	—	1
11–12 yr.	—	—	—
12–13 yr.	—	—	—
Total	400		

* Aged 5 days and 12 days respectively; both ileocolic.
62·5 per cent of patients were under 1 year old;
75·5 per cent of patients were under 2 years old.

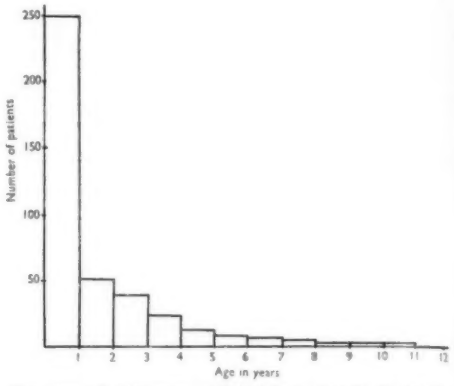

Fig. 553.—A histogram, compiled from data in *Table III*, to show the age distribution of patients (by years).

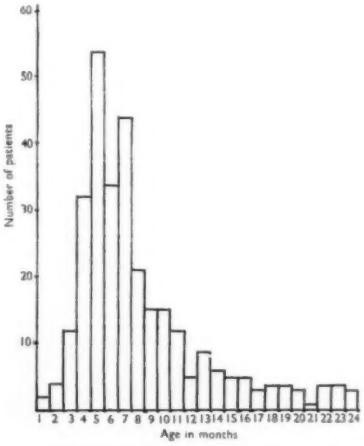

Fig. 554.—A histogram, compiled from data in *Table III*, to show the age distribution of patients (by months).

Table IV.—Analysis of the Various Types of Intussusception encountered in the Series

Type of Intussusception	Total No.	Percentage of Entire Series	No. under 2 Years	Percentage of Each Type under 2 Years	Total Males	Percentage of Males in Each Type	Total Females	Percentage of Females in Each Type	Reducible	Irreducible	Males Irreducible	Females Irreducible	Percentage of Each Type Irreducible	Total Deaths	Percentage Mortality-rate in Each Type	Male Deaths	Female Deaths	Male Deaths as Percentage of Male Patients	Female Deaths as Percentage of Female Patients
Ileocolic	212	53·0	169	79·7	136	64·2	76	35·8	185	27	17	10	12·7	16	7·5	8	8	4·6	8·3
Ileocæcal	137	34·25	107	78·1	80	58·4	57	41·6	134	3	1	2	2·20	5	3·6	2	3	—	—
Colo-colic	18	4·5	7	38·9	12	66·6	6	33·3	18	—	—	—	—	—	—	—	—	—	—
Enteric	25	6·25	13	52·0	14	56·0	11	44·0	22	3	1	2	12·0	2	8·0	2	—	14·3	—
Type unspecified	8	2·0	6	75·0	8	100·0	—	—	8	—	—	—	—	—	—	—	—	—	—
Total of all types	400	100·0	302	75·5	250	62·5	150	37·5	367	33	19	14	8·25	23	5·75	12	11	4·8	7·3

or other types of A.P.C. viruses have been demonstrated in over 50 per cent of infants aged 6–11 months by Huebner, Rowe, Ward, Parrott, and Bell (1954). Kjellen (1955) has recovered A.P.C. viruses from fæces and lymph-nodes of patients suffering from

Table V.—394 PATIENTS (ADMITTED DURING THE COMPLETE YEARS 1946–56) GROUPED ACCORDING TO MONTH OF ADMISSION

	Total Admissions
January	29
February	24
March	47
April	33
May	38
June	44
July	34
August	25
September	21
October	29
November	32
December	38
	394

mesenteric lymphadenitis. Only in very rare circumstances have any bacteria been isolated from inflamed mesenteric lymph-nodes (Strang, 1957).

5. Intussusceptions are much more common in some years than in others (*see Table II*, where, for example, there are more than twice as many cases in 1953 as in 1956). They are also more common at certain times in each year, particularly in winter and spring. It may be significant that viral infections are more prevalent at these seasons. The seasonal incidence is shown in *Table V* and *Fig.* 555.

6. There is often an undue degree of mobility of the ileocæcal region and colon, due to persistence of the fœtal condition of the mesentery. This mobility favours the progress of the intussusception (Fraser, 1926). When the mesentery is very lax the intussusception may progress for a considerable distance before there is much interference with its blood-supply. When the mesentery has undergone the normal process of obliteration or is relatively short, the intussusception will progress for only a short distance before vascular impairment occurs (White and Dennison, 1952).

CLASSIFICATION

In the numerous publications on intussusception there has been some difference of opinion on nomenclature. In this series an attempt has been made to simplify classification, the cases being divided into the following groups:—

Ileocolic.—This type, in which the ileum is invaginated into the colon, probably begins as a prolapse of terminal ileum through the ileocæcal valve (Leichtenstern, 1877). The ileum advances inside the colon for a few inches, with a changing apex, until further progress is arrested by tension on its mesentery (*Fig.* 556 A) (Dennison, 1948). After this stage further advance of the intussusception will be at the expense of the colon (*Fig.* 556 B). Although we believe this to be the usual mechanism, explaining as it does the position of the apex in a constant part of the terminal ileum, yet undoubtedly some intussusceptions begin in the terminal ileum itself by invagination of ileum into ileum. Certainly those which have a Meckel's diverticulum or a polyp at the apex belong to this group. These might be called ileo-ileocolic, but have been included in the ileocolic

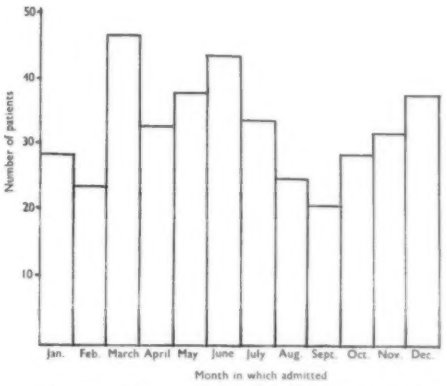

FIG. 555.—A histogram, compiled from data in *Table V*, to show the number of patients admitted in each month during eleven complete years.

group in our scheme. Irrespective of the mechanism, the effects and the appearances at operation are similar:—

1. There is a tendency to early strangulation, due to traction and kinking of the blood-vessels in the mesentery of the terminal ileum and to pressure

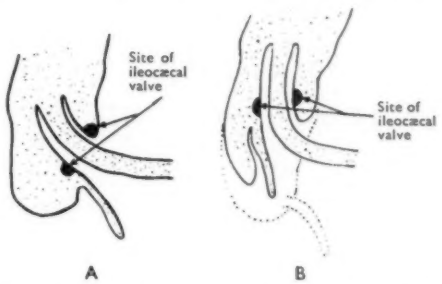

FIG. 556.—Mode of development and progress of the ileocolic type of intussusception.

exerted by the ileocæcal valve through which the ileum has to pass.

2. At operation the early stages of reduction are relatively easy; the appendix is delivered before the intussusception is completely reduced, the ileo-ileal portion still being within the cæcum (*Fig.* 557 B).

3. The final portion is ileo-ileal and this is the most difficult part to reduce (*Fig.* 557 C). The apex is the most likely part to be devitalized. In this series 212 ileocolic intussusceptions were encountered (53 per cent). Twenty-seven (12·7 per cent) were irreducible. There were 16 deaths (7·5 per cent) (*see Table IV*).

Ileocæcal.—In this variety the apex of the intussusception is formed by the ileocæcal valve (*Fig.* 558). Progress is purely at the expense of the colon. At

operation the appendix is the last structure to be reduced. Since the apex of the intussusception is contained within the relatively capacious lumen of the colon and does not have to pass through the narrow ileocæcal valve, as in the ileocolic type, irreducibility and strangulation are less common. There were 137 cases of ileocæcal intussusception, 34·3 per cent of the series. Three were irreducible

CLINICAL FEATURES

The clinical features have been well described by many authors in the past, notably by Morrison and Court (1948). Well-nourished baby boys are the most likely to be afflicted. The medical history has usually been unremarkable prior to the onset of the intussusception (*see Table VI*).

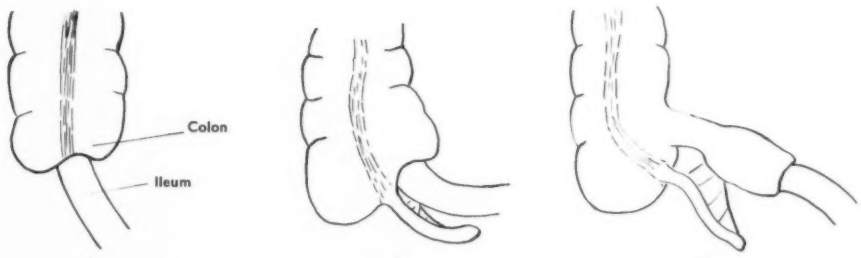

FIG. 557.—Stages in the reduction of an ileocolic intussusception. A, Intussusception nearing final stages of reduction. B, Appendix reduced. Ileo-ileal portion still within cæcum. C, Ileo-ileal portion delivered from cæcum. Reduction almost completed.

(2·2 per cent). There were 5 deaths (3·6 per cent). In practice it is sometimes difficult to be certain at operation whether an intussusception should be classed as ileocolic or ileocæcal. When all cases of ileocolic and ileocæcal intussusception are considered

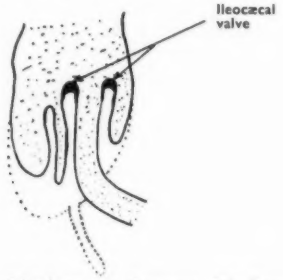

FIG. 558.—Mode of development and progress of the ileocæcal type of intussusception.

together it is found that the mortality-rate of the females is almost double that of the males (*see Table IV*).

Colo-colic.—In this type the colon is invaginated into colon. There were 18 cases in the series (4·5 per cent). In none of the patients was the intussusception irreducible and there were no deaths. This group is thus the least dangerous. Most of the patients were over 2 years of age, in contrast to the other types. No cause was found for the intussusception in any of the patients.

Enteric.—In this type small intestine is invaginated into itself. Twenty-five instances were encountered (6·25 per cent of the series). The ileum was affected in 24 of the patients; in 1 the jejunum was involved in several places. Three were due to Meckel's diverticulum. Three were irreducible. There were 2 deaths (8 per cent).

Abdominal Colic is usually a prominent feature and was present in 300 patients (75 per cent). In 59 per cent of all the patients it was the presenting symptom. It is probably present in every case but may not be appreciated as such by the parents. It is generally severe enough to cause the child to scream and draw up his legs and may be accompanied by pallor and sometimes by perspiration. The attacks of pain are at first of short duration. During the intervals of freedom the child lies quietly and may often appear remarkably well. The attacks become more frequent as the condition continues. When the intussusception has progressed to strangulation, shock may be severe and the child may show no evidence of pain.

Vomiting was present at some time in 320 (80 per cent) of the patients. As a rule it is an early symptom; indeed, in 29 per cent of the patients it was the presenting symptom. At first it is reflex in type and is *not* due to intestinal obstruction. It is probably produced by the drag of the intussusception on the mesentery. The vomitus later contains bile, may become fæculent, and is then the inevitable result of intestinal obstruction. The diagnosis should have been made long before this stage is reached.

Bowel Action.—The bowels may act after the onset of the intussusception and a normal stool may be evacuated. In 251 patients (63 per cent) blood was passed rectally, mainly within the first twenty-four hours. In 104 patients (26 per cent) the blood was mixed with mucus. In 9 per cent of patients passage of blood per rectum was the presenting feature of the illness. In 6 children mucus alone was passed rectally.

Physical Signs.—When seen between attacks of colic, the child may present a surprisingly normal appearance. If seen shortly after an attack he will often appear pale and listless and may be sweating. In many cases the temperature is slightly raised;

when the condition is seen at a late stage the temperature may be quite high. This may be due to dehydration or to reaction to toxins liberated from damaged bowel. Unless seen during an actual spasm of colic, the child is easily examined. Careful palpation of the abdomen will usually reveal a mass and the examination may precipitate a further attack of colic.

Table VI.—State of Previous Health

Previous health unexceptional	306 (79 per cent)
Constipation	42
Diarrhœa	18
Upper respiratory infection	12
Previous intussusception	12
Previous bouts of abdominal colic	3
Pink disease	2
Henoch-Schönlein purpura	2
Measles	1
Mumps	1
Previous blood in stools (no cause found)	1
	400

Fig. 559.—Straight radiograph of a patient in the erect position, showing absence of gas in the colon and distension of terminal part of ileum and of several loops of small bowel. The cæcum is not visible, but, from the position of the gas in the terminal ileum, it is probably displaced upwards. This patient was suffering from an ileocolic intussusception.

When no mass is felt there may still be some guarding of the overlying muscles. In the present series an abdominal mass was palpated in 312 patients (78 per cent). The commonest site was the right hypochondrium (142 patients). In 62 patients a mass was discovered centrally, in 38 in the right iliac fossa, in 37 in the left hypochondrium, and in 33 in the left iliac fossa. Failure to palpate a mass may be due to abdominal distension. Sometimes the child is so fretful that satisfactory palpation is impossible. Sometimes the mass is obscured by the liver. If the diagnosis is in doubt it is the practice in this unit to anæsthetize the child and then re-examine the abdomen. In 7 patients in the series (1·8 per cent) a mass was discovered in this way. In many others (not included in the series) the diagnosis of intussusception was not confirmed and no operation was undertaken.

Rectal Examination.—Blood was obtained on the examining finger in 304 patients (76 per cent). In 115 the blood was mixed with mucus and in 44 patients the blood was mixed with fæces. It is especially emphasized that blood may be discovered on digital examination of the rectum even when there has been no history of rectal bleeding. The blood has been retained by the anal sphincter and will be revealed only by digital examination, which must therefore be carried out in every case. In 4 patients the apex of the intussusception was found to be contained within the rectum. As suggested by Gross and Ware (1948) it was occasionally possible to determine the presence of a mass by bimanual rectal palpation when it could not be discovered by ordinary abdominal palpation. It has not been found necessary to determine the presence or absence of occult blood in the fæces in making the diagnosis.

Fig. 560.—Supine film of the same patient shown in *Fig.* 559. There is absence of gas in the colon and distension of small-bowel loops.

X-ray Examination.—In the patient with typical symptoms and signs radiography is not necessary to establish the diagnosis. The interpretation of the films is often extremely difficult and, even with considerable experience, may be misleading. In an atypical case straight films of the abdomen are obtained, erect and supine views being taken (*Figs.* 559, 560). There is no characteristic picture, but a common finding is absence of gas in

the right lower quadrant of the abdomen and in the large bowel. Very occasionally the outline of the intussusception may be seen on such a film. Sometimes distension of the small bowel may be apparent and a few fluid levels may be observed. In late cases

FIG. 561.—Barium enema showing typical spiral coil appearance at the hepatic flexure due to an intussusception.

the appearances are those common to any small-bowel obstruction. A barium enema will outline the apex of the intussusception as a filling defect in the colon (*Fig.* 561).

We would emphasize again that radiography is not undertaken as a routine investigation in the acute case. Where real doubt exists more positive information will be gained by examination under anæsthesia or, in the final instance, by laparotomy.

TREATMENT

It is now over eighty years since Hutchinson (1874) reported the first successful operative reduction of an intussusception in a child. Shortly afterwards, in 1876, Hirschsprung, of Denmark, reported success in the use of enemata combined with manipulation through the intact abdominal wall. In 1905 he reported a series of 107 patients treated in this way with a mortality-rate of only 35 per cent, a low figure for the period. In 1926 Hipsley, of Australia, published a series of 100 consecutive intussusceptions treated primarily by saline enemata with successful reduction in 62 per cent and an overall mortality-rate of only 5 per cent. Most of the patients, however, were treated at an early stage in the disease, the average duration of symptoms being 17 hours. This method has remained popular in Australia (Nelson, 1949). In 1927 several workers, including Olsson and Pallin, of Sweden, and Retan, of U.S.A., independently advocated reduction by barium enema with fluoroscopic control. Since then this technique has been favoured in Scandinavian countries and in some parts of North America. Nordentoft and Hansen (1955), in a review of 796 patients treated primarily by barium enema between 1944 and 1949, showed that successful reduction occurred in 58 per cent. In that series 80 per cent of the patients were treated within 24 hours of the onset of symptoms. The overall mortality-rate was 9·2 per cent. Zachary (1955) reported 33 successful hydrostatic reductions in 54 patients. He considers the method is most likely to succeed in children over 6 months of age with symptoms of less than 24 hours' duration.

There are certain objections to the routine use of enemata for reduction:—

1. If efforts at reduction prove unsuccessful there has been a delay in relief of a condition in which time is such a valuable factor.

2. There is danger of perforation of the bowel. Three feet is said to be a safe height for the douche can (Ravitch and McCune, 1948).

3. There is the possibility of reducing non-viable bowel. This danger is very remote at the usual pressures employed (Ravitch and McCune, 1948).

4. It is difficult to be sure that reduction is complete. This is probably the greatest objection to the method. In most series about half of the patients are subjected to laparotomy in order to verify reduction or to complete reduction.

5. An enteric intussusception may not be discovered by barium enema and thus may not be reduced.

6. A causative lesion may be missed. It is very uncommon, however, for a causative lesion to be present and such a lesion becomes even more unlikely in the case of young infants in whom the method is most often employed.

All the patients in this series were treated primarily by operation. Laparotomy is performed as soon as the condition of the child permits. When the state of the patient is poor, one or two hours are well spent in resuscitation. Abdominal distension is reduced and vomiting is prevented by continuous gastric aspiration through a nasal or oral tube. An intravenous drip of plasma or quarter-strength saline in 5 per cent glucose is set up. Blood is cross-matched. Most improvement in the patient's condition will have occurred in two or three hours, and as a rule nothing will be gained by persisting with pre-operative measures for a longer period.

When the symptoms are of 24 hours' duration or longer, although the general condition of the patient may appear to be good, it is wise to consider the intussusception as possibly irreducible and to set up an intravenous drip before operation in every case. Occasionally the duration of symptoms is not an accurate guide and, as will be seen from *Table I*, it is possible to encounter irreducibility when symptoms have been present for less than 12 hours. A stomach tube is passed in every case before beginning the anæsthetic.

General anæsthesia was administered to all the patients except one, an ill child on whom operation

was performed after infiltration of the abdominal wall with local anæsthetic. Nitrous oxide, oxygen, and ether have been most commonly employed, but the anæsthetic agent used has always been left to the discretion of the anæsthetist. In this hospital the anæsthetists have special skill and experience in the management of infants and small children. This fact undoubtedly contributes greatly to improvement in results.

The abdomen is entered through a vertical incision, extending about one-third above the level of the umbilicus and two-thirds below and either displacing or splitting the right rectus abdominis muscle. In the first instance it should be as small as is practicable in order to prevent undue escape of distended bowel. The intussusception is palpated within the abdomen and is reduced intra-abdominally as far as possible. Difficulty may be encountered with the last part, which can be brought outside the abdomen and reduced under direct vision. The minimum time is taken with this procedure. Œdema which hinders reduction may be dispersed by gentle squeezing through hot saline packs. It is a good plan to set a time limit when, if reduction has not been effected, the position is reviewed. Following successful reduction the operation is concluded with the least possible delay. The appendix is not removed unless its viability is in doubt; no effort is made to prevent recurrence of the intussusception.

In the present series it was possible to effect reduction in 366 patients (91·5 per cent). There were 9 deaths in this group following operation. The main details are summarized in *Table VII*. It is evident that the commonest cause of death was peritonitis as a consequence of devitalization of the bowel. The duration of the disease in most of the patients who died of peritonitis was three days or more. These findings emphasize the considerable risks which are run if bowel of doubtful viability is returned to the abdomen. It is interesting, in this connexion, to recall the experimental work of Ravitch and McCune (1948). These workers, in the course of their studies on experimentally produced intussusceptions in dogs, found that in 7 out of 13 instances it was possible to culture pathogenic bacteria from the serosal surface of viable intussuscepted bowel.

Table VII.—Reducible Intussusceptions—Post-operative Deaths

Patient	Year	Age	Duration of Symptoms	Type	Pre-operative Condition	Special Pre-operative Treatment	Operative Procedure	Special Post-operative Treatment	Time of Death	Cause of Death
A	1946	14 mth.	48 hr.	Ileocolic	Sunken	—	Reduction of intussusception	Intravenous infusion saline and glucose	6 hr.	Shock
B	1946	2 mth.	12 hr.	Ileocolic	Good	—	Reduction without difficulty	—	3 d.	At autopsy there was an irreducible intussusception of terminal ileum, cæcum, and ascending colon into transverse colon. Gangrenous
C	1947	6 mth.	72 hr.	Ileocolic	Good	—	Reduction with difficulty	—	3 d.	Part of terminal ileum devitalized. Peritonitis
D	1947	10 mth.	6 d.	Ileocolic	Child in poor condition	Intravenous plasma	Reduction without difficulty. Two gangrenous patches oversewn	Intravenous plasma	15 hr.	Toxæmia. Peritonitis
E	1948	5 mth.	55 hr.	Ileo-ileal	Poor	Intravenous plasma	Reduction	Intravenous plasma	5 hr.	Peritonitis. Gangrene of ileum 2 ft. from cæcum
F	1948	3 yr.	6 d.	Ileocolic	Good	—	Reduction of intussusception and appendicectomy	—	6 d.	Liver failure; bronchopneumonia
G	1950	4 mth.	3 d.	Ileocolic	Toxic	Intravenous plasma	Reduction	Oxygen, intravenous plasma	9 hr.	Terminal ileum devitalized. Peritonitis
H	1951	5 mth.	12 hr.	Ileocæcal	Slightly dehydrated. Suffering from pink disease	Intravenous saline	Reduction	Intravenous saline	16 hr.	No cause discovered at autopsy
I	1956	15 mth.	6 d.	Meckel's diverticulum as apex of ileocolic intussusception	Fair	Tetracycline	Reduction of intussusception. Excision of diverticulum	Intravenous blood, intravenous saline	48 hr.	Peritonitis. Gangrene of ileum at site of excised diverticulum

Treatment of the Irreducible Intussusception.—It is a mistake to persevere too long in attempts at reduction for the following reasons:—

1. Prolonged handling of bowel and mesentery in these infants rapidly produces a state of shock and profound collapse.

2. When the intussusception has been reduced with extreme difficulty the bowel may not be viable, or may be so badly damaged that it cannot safely be returned to the peritoneal cavity.

One may thus be compelled to embark on resection or other time-consuming procedures in a child who is already shocked. When the surgeon decides that an intussusception is irreducible several alternative modes of treatment are possible. These include:—

1. Resection of the mass and primary anastomosis.

2. Short-circuit of the mass by side-to-side anastomosis of the bowel proximal and distal to the intussusception, returning the mass to the peritoneal cavity.

3. Exteriorization of the mass as in the Mikulicz operation for colonic tumour, at the same time relieving the obstruction by enterostomy or short-circuit.

In this series 33 intussusceptions were found to be irreducible. They were treated by one or other of the above methods. It is proposed to discuss our experiences with each method in turn.

Resection and Primary Anastomosis.—There is no doubt that this method can yield excellent results in the hands of a surgeon who is specially experienced in bowel resections in children. Denis (1947) reported 7 such resections with survival in every case. In other reports, however, the results have not been so good. Gross and Ware (1948) had a mortality of 83 per cent in a series of 18 resections for intussusception. Ravitch and McCune (1948) reported a mortality rate of 77 per cent in 9 patients.

The disadvantages of the method are:—

1. Considerable shock is produced when the mesentery is cut and handled.

2. Operating time is prolonged.

3. There is danger of leakage at the site of anastomosis.

4. There is danger of peritoneal soiling while the anastomosis is being made.

On the other hand it is simple to decompress the bowel during the operation. The gangrenous bowel, which is liberating toxins, is removed from the body.

In this series resection and primary anastomosis were employed on 5 occasions. The results are summarized in *Table VIII*, from which it will be seen that there were 3 deaths (60 per cent). Deaths occurred within a few hours of operation and were due to shock which failed to respond to transfusion and other measures.

Simple Anastomosis with Return of the Intussusception to the Peritoneal Cavity.—This manœuvre was first suggested by Parry in 1909 and successfully employed by him in a child of six months. Further series have been reported from time to time since then (Rutherfurd, 1909; Montgomery and Mussil, 1930; Elliot-Smith, 1935; White and Dennison, 1952). The method is based on the observation that death in untreated intussusception is only very rarely due to peritonitis. This fact is well shown by a study of 131 cases of intussusception of all kinds, most of them fatal, collected in table form by Waren Tay and shown as an appendix to Hutchinson's paper on intussusception in 1874.

In this method a simple side-to-side anastomosis is made between the ileum and the ascending or transverse colon and the mass is then returned to the abdomen. The procedure is applicable only if, as is usually the case, the viability of the ensheathing layer of the intussusception is beyond doubt. It is rapidly and easily performed and, when successful, the patient usually has a smooth convalescence. Twenty patients were treated in this way. The details are set out in *Table IX*. It will be seen that there were 8 deaths (40 per cent). In 5 of the patients death was due to shock and toxæmia, 4 of the patients dying within 24 hours. These patients were all extremely ill before operation and it is possible that they would have died no matter what procedure had been adopted. On the other hand there is no doubt that toxic absorption may continue from the devitalized bowel which by this method is left within the body. Three of the patients died of bronchopneumonia, 2 of those following a second operation for relief of mechanical obstruction due to adhesions. It is evident that although this method has the advantages of speed and simplicity yet in many patients it will fail. Death is most often due to progressive shock and toxæmia, and it is concluded that where there is a possibility of gangrenous bowel being present such bowel is best removed.

Table VIII.—Irreducible Intussusceptions treated by Resection and Primary Anastomosis

No.	Year	Age	Duration	Type	Operation	Result
1	1946	8 mth.	72 hr.	Ileocolic	Resection of gangrenous part of ileum. Side-to-side anastomosis	Good recovery
2	1947	3 mth.	24 hr.	Ileocolic	Intussusception, resected transcæcally	Died 4 hr. after operation—shock
3	1951	6 mth.	5 d.	Ileocolic	Intussusception irreducible at splenic flexure. Resection performed as far as sigmoid colon	Died 11 hr. after operation—shock
4	1955	9 mth.	36 hr.	Ileocolic	Resection of irreducible part in terminal ileum. End-to-end anastomosis	Good recovery
5	1957	6 mth.	96 hr.	Ileocolic	Resection of devitalized part of terminal ileum and end-to-end anastomosis	Died 12 hr. after operation—shock

It is of interest that in patient No. 15, when the intussusception was re-inspected at the secondary operation, reduction was easily accomplished. In several of the patients radiological examination with barium was performed some weeks after operation; no evidence of the ileotransverse colostomy could be found and the anatomy of the ileocæcal region appeared normal. It would seem that in these patients, also, spontaneous reduction had occurred. In patients Nos. 6, 7 the intussusception was passed rectally as a slough.

Table IX.—Irreducible Intussusceptions treated by simple Anastomosis with Return of Intussusception to Abdomen

No.	Year	Age	Duration	Type	Operation	Result
5	1946	9 mth.	5 d.	Ileocæcal	Ileum anastomosed to descending colon	Died in 4 hr.—shock
6	1946	7 mth.	14 hr.	Ileocolic	Ileotransverse colostomy	Good recovery
7	1946	4 mth.	12 hr.	Ileocolic	Ileotransverse colostomy	Good recovery
8	1946	4 mth.	48 hr.	Ileocolic	Ileotransverse colostomy	Good recovery
9	1946	5 yr.	3 d.	Ileo-ileal	Irreducible (in terminal ileum). Ileotransverse colostomy performed	Satisfactory recovery
10	1947	7 yr.	7 d.	Ileo-ileal	Ileo-ileal anastomosis	Died 2 d. after operation. Toxæmia (no autopsy)
11	1948	6 mth.	56 hr.	Ileocæcal	Ileum anastomosed to descending colon	Died 3 d. after operation. Autopsy: bronchopneumonia. No peritonitis
12	1948	4 mth.	18 hr.	Ileocolic	Ileotransverse colostomy	Died 24 hr. after operation—shock and toxæmia (autopsy)
13	1948	10 mth.	5 d.	Ileocolic	Ileotransverse colostomy	Good recovery
14	1948	4 mth.	72 hr.	Ileocolic	Ileotransverse colostomy	Good recovery
15	1949	4 mth.	10 hr.	Ileocolic	1. Ileotransverse colostomy 2. Abdomen re-explored after 4 d. for relief of mechanical obstruction due to adhesions	Died 5 d. after second operation—bronchopneumonia
16	1949	2 mth.	48 hr.	Ileocolic	1. Ileotransverse colostomy 2. Abdomen re-explored after 11 d. for relief of mechanical obstruction due to adhesions	Died 1 d. after second operation—bronchopneumonia
17	1949	3 mth.	30 hr.	Ileocolic	Ileotransverse colostomy	Good recovery
18	1951	6 mth.	14 hr.	Ileocolic	Ileotransverse colostomy	Good recovery
19	1952	2 mth.	48 hr.	Ileocæcal	Ileotransverse colostomy	Died 7 hr. after operation—shock
20	1952	2½ yr.	12 hr.	Ileocolic	Ileotransverse colostomy; abdomen drained	Good recovery
21	1953	23 mth.	3 d.	Ileocolic	Ileotransverse colostomy	Good recovery
22	1954	17 mth.	5 d.	Ileocolic	Ileo-ileal anastomosis	Died 24 hr. after operation—toxæmia, paralytic ileus; no peritonitis
23	1954	4 mth.	36 hr.	Ileocolic	Ileotransverse colostomy	Good recovery
24	1955	6 mth.	5 d.	Ileocolic	Ileo-ileal anastomosis	Good recovery (paralytic ileus, 48 hr.)

Exteriorization.—Eight patients were treated by exteriorization of the intussusception, combined with some procedure for overcoming intestinal obstruction. The main details in their treatment are set out in *Table X*.

In 3 of the patients ileostomy was performed at the time of exteriorization. In the remaining 5 patients ileotransverse colostomy was performed. There were 2 deaths (M.R. 25 per cent). One death was due to leakage at the site of the ileotransverse anastomosis, the other was due to inhalation of vomitus. Of the 6 patients who survived, 4 underwent right hemicolectomy as a secondary procedure at intervals varying from one day to three months. In the remaining 2 surviving patients the exteriorized bowel was later returned to the abdomen. From the experience with these patients it appears: (1) That exteriorization of the intussusception is well borne by these very ill infants. (2) The exteriorized bowel will usually require to be excised. This can be accomplished at the time of the primary operation. (3) The intestinal obstruction can easily be relieved by the ileostomy which is formed when the bowel is resected. Such an ileostomy is easily managed during the few days that it requires to be open. With modern techniques of maintenance of fluid balance there is little danger.

Such a procedure was fully described by Gross and Ware (1948) in a series of 14 irreducible intussusceptions treated by exteriorization with a mortality of 23 per cent, and by Jones (1953) who described a series of 9 patients treated in a similar way with only 1 death. The essential details in the method are:

Table X.—IRREDUCIBLE INTUSSUSCEPTIONS TREATED BY EXTERIORIZATION

No.	Year	Age	Duration	Type	Operation	Result
25	1947	18 mth.	24 hr.	Ileocolic	1. Mass exteriorized. Ileotransverse colostomy performed 2. Prolapse of small intestine through operation wound on second day. Re-suture of wound	Died. Inhaled vomitus after second operation
26	1949	3 mth.	4 d.	Ileocolic	1. Mass exteriorized. Ileotransverse colostomy performed 2. Three wk. later: mass returned to abdomen—fæcal fistula formed 3. Two mth. later: right hemicolectomy	Good recovery
27	1949	3 mth.	30 hr.	Ileocolic	1. Mass exteriorized. Ileotransverse colostomy performed 2. Two d. later: right hemicolectomy	Good recovery
28	1949	4 yr.	3 d.	Ileocolic	1. Mass exteriorized. Anastomosis performed between ileum and ascending colon 2. Four wk. later: right hemicolectomy	Good recovery
29	1951	4 mth.	7 d.	Ileocolic	1. Mass exteriorized—mesentery not divided. Tube inserted into ileum 2. Twenty-four hr. later: bowel viable; intussusception easily reduced; returned to abdomen and ileostomy closed	Fæcal fistula for several days. Eventual good recovery
30	1952	17 mth.	100 hr.	Ileocolic	Mass exteriorized. Ileotransverse colostomy performed	Died on fourth day. Leakage from anastomosis—peritonitis
31	1952	5 mth.	72 hr.	Ileo-ileal (inverted Meckel's diverticulum)	1. Mass exteriorized and resected. Obstruction relieved by ileostomy 2. Closure of ileostomy	Good recovery
32	1953	3 mth.	34 hr.	Ileocolic	1. Mass exteriorized. Ileostomy performed 2. Intussusception reduced and returned to abdomen on fifth day. Ileostomy opening anastomosed to a tear in cæcum	Good recovery

The intussusception is mobilized by division of the mesentery and is delivered out of the abdominal wound, which is then carefully closed around it. Clamps are then applied to either end of the loop and the mass is excised. A small Paul's tube may be tied into the ileostomy. The ileostomy is closed by a formal intraperitoneal anastomosis at the earliest possible moment, generally within two or three days.

POST-OPERATIVE CARE

Following the successful reduction of an intussusception a few special measures are adopted. The pulse, temperature, and respiration rate are charted hourly for the first 24 hours. A falling pulse-rate is the best indication of improvement, while a slight rise in temperature during the first day is the rule. If post-operative collapse occurs it is combated with intravenous blood and plasma. Intragastric suction is continued intermittently for 12 hours and then oral fluids may be begun.

After operation for irreducible intussusception extremely careful supervision is required. Frequent estimations are made of pulse, temperature, and respirations. The patient is nursed in an incubator or oxygen tent. Intragastric suction is continued for 24 hours or until evidence of intestinal obstruction has gone. Careful check is kept on fluid balance and lost fluids are replaced intravenously, blood, plasma, and saline usually being required. The plasma electrolytes are estimated daily. A broad-spectrum antibiotic is given, principally to prevent the onset of pneumonia. Intramuscular tetracycline is the drug of choice at present.

Recurrence.—Recurrence of the intussusception was noted in 12 patients (3 per cent of the series). The details are summarized in *Table XI*. It will be seen that recurrence usually took place between two and six months after the original reduction. In only 1 patient did the intussusception recur on more than one occasion.

Table XI.—RECURRENCES OF INTUSSUSCEPTION

No.	Sex	Age	Type of First Intussusception	Interval between Intussusceptions	Type of Second Intussusception
1	M.	5 d.	Ileocolic	5 mth.	Ileocolic
2	M.	4 mth.	Ileocolic	6 mth.	Ileocolic
3	M.	5 mth.	Ileocæcal	2 mth.	Ileocolic
4	M.	5 mth.	Ileo-ileal	4 mth.	Ileocolic
5	M.	5 mth.	Ileocolic	1 mth.	Ileo-ileal
6	M.	5 mth.	Unspecified	10 mth. 5 yr.	Unspecified Ileocolic
7	F.	6 mth.	Ileocæcal	2 mth.	Ileocolic
8	M.	15 mth.	Unspecified	21 mth.	Ileocolic
9	F.	23 mth.	Ileocolic	8 mth.	Ileocolic
10	F.	2 yr.	Ileocolic	7 mth.	Ileocæcal
11	M.	2½ yr.	Ileocolic	6 mth.	Ileocolic
12	M.	2½ yr.	Ileocolic	1 mth.	Ileo-ileal

SUMMARY

A series of 400 cases of intussusception is reviewed. Earlier diagnosis will lead to further overall improvement in results. Since 1951 there have been no deaths in 145 patients with symptoms of 24 hours' duration or less. The aetiology of the condition is

briefly discussed with special reference to a possible connexion with mesenteric lymphadenitis.

The various types of intussusception encountered in the series are described.

An account is given of the clinical features and the mode of presentation of the disease.

The treatment of the reducible intussusception as employed in this unit is described. Reference is made to the methods used in the past and in other centres. An analysis is made of three procedures used in the treatment of 32 cases of irreducible intussusception. The best results were obtained by exteriorization.

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SURGICAL REPAIR OF A TRAUMATIC RUPTURE OF THE THORACIC AORTA

By F. ELLIS

NEWCASTLE UPON TYNE REGIONAL THORACIC SURGERY CENTRE, SHOTLEY BRIDGE HOSPITAL

TRAUMATIC rupture of the otherwise healthy thoracic aorta is a well-known autopsy finding in victims of road, rail, and air accidents.

It is now more widely recognized that aortic rupture may occur without causing immediate death, and may present after varying periods of time as an aortic aneurysm.

The following report is of interest for several reasons: (1) Traumatic shock was minimal at the time of the accident, no blood transfusion or other supportive therapy being required. (2) Symptoms and signs of a major intrathoracic disaster were absent until the eighth day after injury. (3) A correct pre-operative diagnosis was made and surgical repair carried out within 26 hours from the onset of these symptoms. (4) Although this patient did not survive, attention may be drawn to the possibilities of early diagnosis and surgical cure in similar acute cases.

CASE RECORD

A. S., male, aged 30 years.

On March 30, 1957 was admitted to another hospital after a driving accident, in which he was thrown forward, striking his chest against the steering column. On admission he was conscious but dazed and complained of pain in the back, left chest, and right knee, and of slight dyspnœa. Clinical and radiological examination showed fractures of the right patella, left second rib, and first lumbar vertebra.

His condition caused no anxiety and on the sixth day after injury the fractured patella was excised under general anæsthesia. On the following day his condition was satisfactory except for a mild pyrexia and slight cough. On April 7, the eighth day after injury, at 8.0 a.m. he complained of sudden, gripping pain at the lower end of the sternum together with severe dysphagia. Dyspnœa became marked and stridor developed. A diffuse swelling of the lower neck appeared and his cough increased in severity, producing large amounts of frothy sputum. A chest radiogram taken at this time showed broadening of the superior mediastinum and an opacity at the left base, diagnosed as a hæmothorax (*Fig.* 562).

Throughout the day the dyspnœa, stridor, and dysphagia increased, the neck swelling extended, and hoarseness developed. Aspiration of the left chest withdrew 16 oz. (454 ml.) of bloody fluid, with some relief of the dyspnœa.

In view of the mediastinal shadowing and signs of upper respiratory obstruction, a diagnosis of mediastinal hæmatoma was made by Dr. R. Wilsdon, with whom Mr. W. C. Barnsley later saw the patient, aortic rupture then being suspected.

On April 8 at 3.0 a.m. the patient was transferred to the Newcastle upon Tyne Regional Thoracic Surgery

Centre at Shotley Bridge Hospital. The dyspnœa and stridor had improved slightly though dysphagia was complete. General condition was good; pulse 100/min., regular, and of good volume. B.P. 100/70. There was no cyanosis or distension of the neck veins. The carotid, radial, and femoral pulses were present and equal in volume on each side.

The neck showed a soft, tender, non-fluctuant swelling which extended bilaterally up to the level of the thyroid cartilage. No surgical emphysema was present over the neck or chest. Chest examination showed impaired percussion and air entry at the left base. A systolic murmur was heard along the right parasternal border and a 'to and fro' murmur, accentuated in systole, was heard in the upper interscapular area in the midline.

FIG. 562.—Radiograph of the chest showing broadening of the mediastinum and a left hæmothorax.

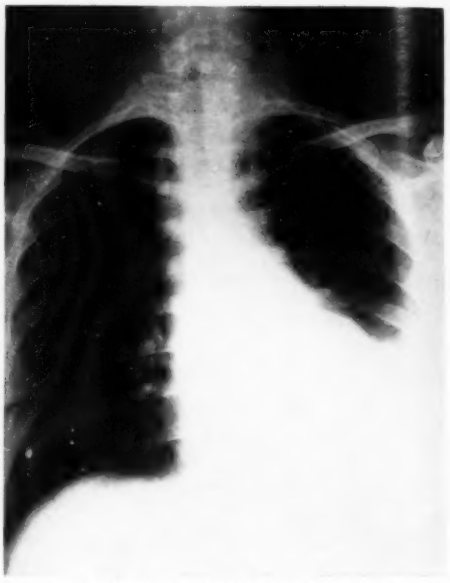

FIG. 563.—Radiograph showing the obscured aortic arch outline.

FIG. 564.—Radiograph showing compression and forward displacement of trachea.

Investigations: W.B.C. 14,000. R.B.C. 3·96 m./cu. mm., Hb 80 per cent, P.C.V. 35 per cent. E.C.G. in standard leads showed no abnormality. Chest radiographs revealed broadening of the superior mediastinum with considerable forward displacement and compression of the trachea, and confirmed the left basal effusion (*Figs.* 563, 564).

On the history and clinical and radiological findings a diagnosis of aortic rupture was made.

In the following 6 hours the patient's condition remained stable, there was no gross increase in respiratory obstruction and no sign of fresh intrathoracic bleeding. This apparent well-being prompted discussion as to the advisability of immediate operation, but in view of the probably increasing risk of massive hæmorrhage thoracotomy with the use of hypothermia was decided upon.

At 10.30 a.m. anæsthesia was induced and surface cooling started, using ice bags and refrigerating blanket, under the control of Dr. E. J. Millar. Endotracheal intubation did not provide an adequate airway and bronchoscopy confirmed that the lower trachea, immediately above the carina, was almost completely occluded by pressure from the left side.

This difficulty with the airway produced an urgent situation and necessitated an immediate start to the operation, to deal with the aneurysm and relieve tracheal compression. Cooling therefore was not adequately advanced.

OPERATION (Mr. G. A. Mason).—The left chest was entered by a posterolateral incision below the 4th rib and a large quantity of heavily blood-stained pleural effusion was found. The lower lobe of the lung was collapsed and consolidated and the upper lobe also showed early consolidation. At the junction of the aortic arch and the descending aorta, a tense pulsating mass was present, which

extended up to and around the aortic arch and half-way down the descending aorta (*Fig.* 565). One point on the wall of the aneurysm was thin and showed marked pulsation, and it appeared that rupture might be imminent. The whole mediastinum was infiltrated and virtually 'frozen' with organizing blood, forming a rigid mass which made dissection and anatomical recognition very difficult. The left stem bronchus was stretched and compressed and the tracheobronchial junction grossly

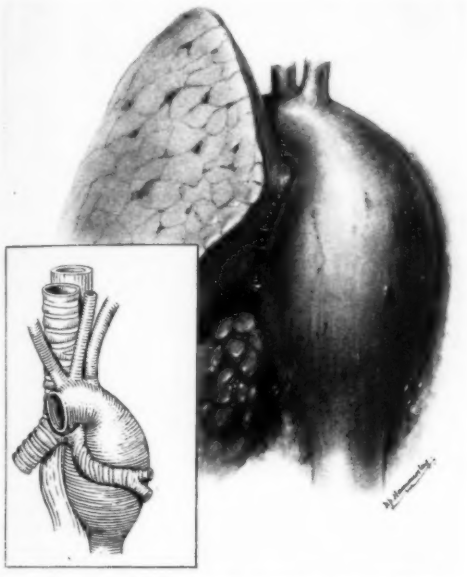

FIG. 565.—Appearances at operation. *Inset*: showing compression and distortion of the œsophagus, lower end of trachea, and left main bronchus.

distorted by pressure from the aneurysm, these findings corresponding with those at bronchoscopy. The œsophagus was also compressed by the aneurysm at the level of the left bronchus.

The space between the back of the lung root and the aorta was opened, and by dissecting up along the pulmonary artery to the ligamentum arteriosum and dividing it and the recurrent laryngeal nerve, it was just possible for two fingers to meet around the aortic arch, immediately inferior to the left subclavian artery, and so define a site for proximal cross-clamping of the aorta. After clamping the aorta at this site, the false sac was incised, evacuating blood and clot, and a second clamp applied below the aneurysm. The false sac of adventitia and infiltrated mediastinal tissue was excised, and the ends of the completely transected aorta were then seen to be lying approximately 2 in. apart (*Fig.* 566). A formalin prepared aortic homograft (Nuboer, 1954) was inserted with good restoration of continuity. Aureomycin was instilled into the mediastinum and the chest closed with a tube drain in position. The actual operating time for thoracotomy and insertion of the graft was 3½ hr. At the conclusion of the operation an incision was made in the suprasternal notch to act as a pressure relieving drain in the superior mediastinum.

Details of Hypothermia and Aortic Occlusion.—The patient was a moderately obese male, approximately 196 lb. (80·2 kg.) in weight, and was pyrexial before operation—100° F. (37·8° C.). These factors precluded a rapid rate of cooling and the aorta had to be clamped at 36·3° C., because of the need to proceed rapidly with the operation. Aortic occlusion lasted 96 min. and during this time the temperature dropped to 33° C., finally reaching 32·5° C. when the clamps were removed. Intensive efforts at rewarming did not prevent a further drift to 30° C. and some time elapsed before the temperature rose to normal levels. No evidence of cardiac arrhythmia was observed during the operation or whilst rewarming took place. Voluntary breathing and consciousness returned

FIG. 566.—Appearances after partial excision of the false sac, showing the transected and separated aorta.

satisfactorily but ischæmic cord damage had obviously occurred as power and sensation were absent in the lower limbs. Good femoral pulses were present. The patient left the operating theatre at 10.0 p.m. with a regular pulse, 100/min., B.P. 100/70, and satisfactory respirations. Seven pints (3½ l.) of blood had been transfused. At 10.25 p.m. he suddenly collapsed with cardiorespiratory failure; resuscitation and cardiac massage did not evoke any response from a toneless heart.

Autopsy was performed 12 hr. later and did not show any cause for sudden death, the graft was patent and the suture lines intact; no other abnormality was found except for the skeletal injuries already noted.

DISCUSSION

Incidence.—The incidence of traumatic rupture of the aorta is difficult to assess as much necropsy material remains unpublished. Examples have been reported, amongst others, by Copeland (1914), Kemp (1923), Griffiths (1931), Kleinsasser (1943), Kastl (1953), and Rice and Wittstruck (1951), whilst Strassmann (1947) described 72 cases in 7000 autopsies from the Medical Examiner's Office of New York.

The frequency with which non-fatal rupture occurs is unknown, though the resultant aneurysms are now recognized more frequently. Successful resection and grafting has been reported by Bosher and Decker (1957), Gerbode (1957), King and Shumacker (1957), and others, whilst Storey, Nardi,

and Sewell (1956) have reviewed 6 cases, including 1 case of their own, and more recently Cooley, De Bakey, and Morris (1957) have reported 7 personal successes. All these patients, however, were operated upon some considerable time after the original injury, and the acute situation described in this report was not present.

Site.—Rupture may occur at any point along the aorta from immediately above the valve cusps down to the level of the diaphragm, but most frequently it is found at the aortic isthmus below the origin of the left subclavian artery. The majority of reported examples have been at this classical site. Rice and Wittstruck (1951) point out that this site becomes that of predilection because it is the junction of the relatively fixed arch and the more mobile descending aorta, and so is rendered vulnerable to decelerating forces, with rupture occurring at the ligamentous insertion.

According to Wilson and Roome (1933) rupture is more likely to occur if the blow is received at the beginning of diastole of the heart, as the aorta is then completely distended with blood.

If the rupture is not to be immediately fatal the adventitia must remain intact, and together with the mediastinal pleura, act as a barrier to exsanguination. Strassmann (1947) found that in 72 autopsy examples, 64 had rupture of all layers and of these 59 died within one hour of the accident. The remainder, including 8 with an intact adventitia, died at varying intervals up to 18 hours.

Rupture may involve the whole or part of the circumference of the aorta, the former being more common, though the latter probably offers a better chance of initial survival.

Diagnosis.—Non-fatal rupture of the aorta at this site, with the formation of a traumatic aneurysm, does not appear to cause any specific clinical picture at least in the early stages. In this patient symptoms and signs were absent until the eighth day after injury; Rice and Wittstruck (1951) described a patient who showed no features to suggest aortic rupture until death occurred suddenly twenty days after injury.

This absence of early diagnostic criteria has been noted in other reported examples, and is the chief cause of delay in investigation and in recognition. Clinical examination revealed the heart murmurs already described; the presence of an interscapular murmur is of interest, as in one of the patients of Goyette, Blake, Forsee, and Swan (1954) a grade II systolic murmur was found over the base and in the interscapular area. The finding of this interscapular murmur, either of a systolic or 'to and fro' type, may be of help in the diagnosis.

The stridor, dyspnœa, and dysphagia may be explained by the marked tracheobronchial and œsophageal compression, and by the extensive mediastinal extravasation. In retrospect, the radiograph taken on initial admission showed slight mediastinal shadowing but in the absence of thoracic symptoms was passed without comment.

The finding of a hæmothorax is a frequent feature of aortic rupture at this site; the 2 patients described by Storey, Nardi, and Sewell (1956) showed left-sided hæmothoraces, as did this patient. A left-sided hæmothorax was found in 12 per cent of cases of dissecting aneurysm of the thoracic aorta by Baer and Goldburgh (1948), and it seems that bleeding from aortic aneurysms affects the left pleural space more frequently than the right. When fractures of thoracic bones are present, the hæmothorax is frequently ascribed to them; the combination of a hæmothorax and mediastinal broadening, however, should raise the possibility of aortic rupture being the cause.

Other radiological signs of rupture at this site are distortion and irregularity of the aortic arch outline, and a 'layering' effect may be seen, doubling or trebling the outline, though this sign is not diagnostic (Wyman, 1953; Goyette and others, 1954). The finding of a pulsating mass on screening would be an invaluable aid in the diagnosis, and screening should be performed in all cases where the condition of the patient enables this to be carried out. Confirmation of the diagnosis and more accurate localization of the site of rupture by aortography, was immediately dismissed because of the danger of causing a sudden, fatal rise in intra-aortic pressure.

Treatment.—Immediate thoracotomy and excision of the aneurysm is the only treatment in the acute case, as the risk of exsanguination is always present and appears to increase progressively. The fortunate few who survive, to present months or years later with stable aneurysms, must be a very small minority of those surviving the initial rupture. This must be a cogent reason for urgent operation. It is obviously impossible to differentiate those acute aneurysms which may be safely observed until conditions are ideal for excision, from those in which early operation is required.

The greatest problem in the surgery of thoracic aortic aneurysms arising at this level is the prevention of the grave sequelæ which may follow high aortic occlusion. General hypothermia and by-pass shunts are accepted methods of dealing with this problem. In 6 successful cases of excision of aneurysm at this site reviewed by Storey, Nardi, and Sewell (1956), hypothermia was used in 2, by-pass shunt in 2, hypothermia and hypotension in 1, and by-pass with hypotension in 1. Each of these methods has its own disadvantages, however, and a more recently developed technique appears to be superior.

Cross, Yoichi, Jones, Hudack, and Kay (1955) presented an experimental study of aortic occlusion using a pump to shunt blood from the left subclavian artery to the femoral artery during the period of occlusion. King and Shumacker (1957) report the further use of a similar technique, and of superior vena-cava femoral artery by-pass, in experimental and clinical cases. Vena-cava femoral artery by-pass was used in 4 patients and brachial-to-femoral shunt in 1. The latter patient was a 30-year-old man found to have an aortic aneurysm 10 years after an automobile accident. The aneurysm arose at the level of the ligamentum arteriosum, the typical site for traumatic aneurysms, and extended 4½ in. distally. Successful resection and grafting was later performed, aortic occlusion lasting 1 hr.

Cooley, De Bakey, and Morris (1957) have described their experience with 'controlled extracorporeal circulation' in the excision of thoracic aortic aneurysms. For those aneurysms arising below the origin of the left subclavian artery and

requiring by-pass of only a segment of aorta, the proximal cannula was inserted into the left subclavian artery or left auricular appendage, the latter being the route of choice. Pulmonary vein cannulation was found to be unsatisfactory because of congestion in the corresponding lung segment. In 2 male patients with aneurysms situated immediately below the left subclavian artery, this method was used successfully.

Gerbode, in a discussion of Cooley's paper, described 4 patients with traumatic aneurysms resulting from the complete tearing and separation of the aorta at the classical site. One of these aneurysms was excised, using a similar pump circulation, with satisfactory result.

This technique has obvious advantages over hypothermia and the more usual type of extraluminal shunt, in preventing the derangements which follow high aortic occlusion. It obviates a sometimes lengthy period in the operative procedure for the construction of by-pass anastomoses and, as fully oxygenated blood continues to reach the aorta beyond the occlusion, the chances of ischæmic cord damage are much reduced. If such a situation as described in this report were encountered again, the method of choice in dealing with the problem of aortic occlusion would be this technique. The neurological damage which resulted in this patient must in part be attributed to the clamping of the aorta at the relatively high temperature of 36·3° C., which was dictated by the urgency of the situation. From previous experience and from other reported cases, it is possible that some degree of recovery was likely.

The sudden death of this patient remains largely unexplained; blood loss was accurately replaced, and, except for the neurological lesion, his condition appeared to be satisfactory on leaving the theatre. Consolidation of the lower lobe of the lung and continuing partial collapse of the trachea, by causing minor degrees of anoxia, probably contributed to cardiac arrest.

SUMMARY

A man aged 30 years, who sustained a blow on the chest from a steering column, presented 8 days later with acute mediastinal compression and other features, very suggestive of rupture of the thoracic aorta.

Operation and the insertion of an aortic homograft was performed 26 hr. after the onset of symptoms; death occurred from cardiac arrest in the early post-operative period.

The possibility of this injury should be considered in any patient who suffers an accident involving decelerating forces to the thorax, and who, after a varying interval, shows signs of intrathoracic bleeding and superior mediastinal compression.

Clinical diagnosis can only be tentative, but the radiological finding of distortion of the cardiac or mediastinal outline, together with the presence of a hæmothorax, are firmer diagnostic signs.

Every effort should be made to establish a diagnosis as soon as possible, as immediate thoracotomy, with the insertion of a homograft or prosthesis, is of the greatest urgency.

To deal with the problem of aortic occlusion at this level, the use of the pump-controlled shunt technique is advocated.

I am grateful to Mr. G. A. Mason for permission to publish and for advice in the preparation of this paper; and to Professor R. S. Pilcher for comments on the text. To Mr. D. P. Hammersley, Department of Surgery, University of Durham, I am indebted for the drawings.

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BILATERAL ADENOLYMPHOMA OF THE PAROTID SALIVARY GLAND ASSOCIATED WITH TUBERCULOSIS

By H. J. SHAW and I. FRIEDMANN

FROM THE ROYAL NATIONAL THROAT, NOSE AND EAR HOSPITAL, LONDON, AND THE ROYAL NAVAL HOSPITAL, CHATHAM

FIRST described as distinct and separate entities by Albrecht and Arzt in 1910, the origin of these benign cystic tumours has been much debated. Subsequent early accounts by Nicholson (1923) in this country and Warthin (1929) in the United States of America have been followed by a gradually increasing amount of interest. In the last fifteen years the number of new cases reported has risen to around 300 and much closer attention has been paid to their histopathology, as with salivary tumours in general. This has led to a clearer understanding of their nature, and to a realization that, although uncommon, they are not such rarities as was formerly believed.

Further discussion of the other main theories of histogenesis put forward (Warthin, 1929; Hamperl, 1931; and Kraissl and Stout, 1933) no longer seems particularly relevant or profitable, since it is now widely accepted that these tumours are in fact adenomata of heterotopic salivary tissue in the regional parotid lymph-nodes (Albrecht and Arzt, 1910; Nicholson, 1923). Recent detailed investigations by Thompson and Bryant (1950) and Friedman (1952) have amply confirmed the original work of Neisse (1898) and Nicholson (1922), by demonstrating the presence of adenoidal lymph-nodes in the parotid region of embryos and of the newborn infant.

In reporting the present 2 cases of bilateral adenolymphomata further evidence is offered to support the validity of the theory of lymph-node origin, based upon characteristics such as the frequency of bilateral occurrence and the multiple nature of some of these tumours. The finding of active tuberculous infiltration in one tumour of 1 of the present cases lends further strength to these views on histogenesis. The combination of tuberculosis and adenolymphoma has been reported only 3 times before and will be discussed in relation to the important paper by Collins and Shucksmith (1953) on this subject.

CASE REPORTS

Case 1.*—A. C., white, male, aged 56 years (retired). *Sept.* 12, 1955.—Attended the Royal National Throat, Nose, and Ear Hospital complaining of a small wart in his left external auditory meatus during the last three months. Conscious of a swelling in the left upper neck for at least the past year.

Past History: Adenolymphoma of the right parotid salivary gland removed in March, 1953, at the Middlesex Hospital, London.

On Examination: A small keratinized nodule was found on the floor of the left external auditory meatus. No local ulceration or induration. Tympanic membranes normal. A firm, non-tender, mobile, and discrete swelling about 4 cm. in diameter was present at the lower pole of the left parotid salivary gland between the anterior border of the sternomastoid muscle and the angle of the mandible. Regional and general systemic examinations revealed no other abnormalities.

Treatment: Left aural "papilloma" removed under local anæsthesia.

Table I.—CLINICAL OBSERVATIONS

No.	Hospital	Initials	Sex	Age	Clinical Diagnosis	Unilateral or Bilateral	Culture	Unusual Features
1	Royal National Throat, Nose and Ear	J. L.	M.	56	? Tuberculous gland or mixed parotid tumour	Unilateral right	N.D.	—
2	R.N.T.N.E.	I. W.	M.	39	Left otorrhœa from posterior perforation. Swelling left side of neck	Unilateral right	Sterile	—
3	R.N.T.N.E.	E. F.	F.	72	Lump below right angle of jaw. Deafness	Unilateral right	Sterile	—
4	R.N.T.N.E.	G. C.	M.	63	Nasal polypi. Right branchial cyst	Unilateral right	Sterile	—
5	R.N.T.N.E.	H. S.	M.	58	Swelling left parotid. Bilateral deafness	Unilateral left	N.D.	—
6	R.N.T.N.E.	A. T.	M.	64	Right chronic suppurative otitis media. Parotid swelling	Unilateral right	N.D.	—
7	R.N.T.N.E.	A. C.	M.	56	Squamous-celled carcinoma left external meatus, 1955 1953: Adenolymphoma right parotid 1955: Adenolymphoma left parotid	Bilateral	N.D.	Bilateral
8	Royal Naval Hospital, Chatham	S. S. C.	M.	33	Bilateral parotid swelling	Bilateral	Negative for *Mycobacterium tuberculosis*	Associated with tuberculosis

* This case is additional to those reported by Friedmann (1953). The total number treated at this centre is now 7 for the period 1948–57. *Table I* illustrates the sex and age distribution of these cases, their clinical diagnosis, and the frequent association with ear disease.

Pathological Report: Squamous-celled carcinoma.

Oct. 12.—

Further Treatment: H.V.T. 5200 r to the primary site and 8400 r to the left upper neck field, given at Royal Marsden Hospital, London.

Nov. 10.—No change in size of the swelling in the left neck. Left external auditory meatus healed and free of disease.

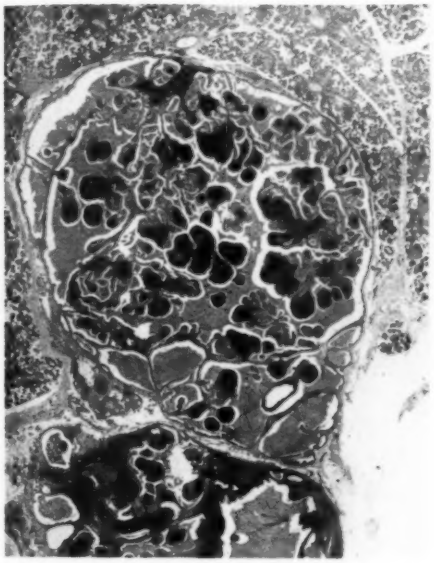

FIG. 567.—Full section of parotid adenolymphoma showing its characteristic papillary cystic structure. H. and E. (×7.)

Provisional Diagnosis: Adenolymphoma of the left parotid salivary gland.

Nov. 16.—

Operation: Excision of the mass in the left upper neck under general anæsthesia. A large softish well-defined swelling (5 × 4 × 4 cm.) was easily dissected out from the deep neck tissues between the sternomastoid muscle and the left angle of the mandible. It appeared attached to, but not within the tail of, the parotid salivary gland.

Dec. 2.—Well healed. Discharged. For out-patient follow-up.

Pathological Report: Salivary-gland tissue containing a typical adenolymphoma lying within a fibrous capsule. No evidence of malignant change or secondary carcinoma in the specimen (*Figs.* 567, 568).

Nov. 5, 1956.—No signs of recurrence in the left ear or the left neck. Mild auriculotemporal syndrome on the left side since the last operation.

Case 2.—S. S. C., white, male, aged 33 years (Flight Sergeant, Royal Air Force).

April 24, 1957.—Admitted to the Royal Naval Hospital, Chatham, complaining of the sudden development of bilateral swellings of his upper neck in the past 24 hours. No pain, no other complaints. They were not present when shaving in the morning, but he noticed them later the same day.

Past History: Mumps at age of 8 years, otherwise nil relevant.

Examination: Bilateral, softish, non-tender, mobile, circumscribed swellings, between the angles of the mandible and anterior borders of the sternomastoid muscles. One small mobile lymph-node palpable in the mid-zone of the left anterior cervical triangle. No other lymphadenopathy. No pyrexia.

Regional and general physical examination showed no abnormality.

Provisional Diagnoses: (1) Bilateral non-specific lymphadenitis or parotitis; (2) Bilateral benign salivary tumours; (3) Malignant lymphoma.

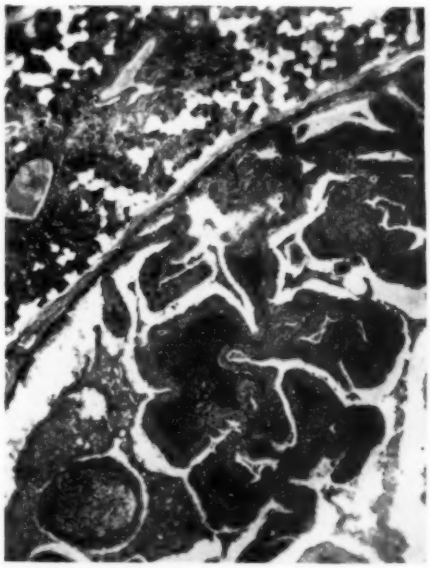

FIG. 568.—As *Fig.* 567, showing the characteristic epithelial-cell pattern and lymphoid stroma of adenolymphoma. Note fibrous capsule separating the tumour and parotid tissue. H. and E. (×45.)

Investigations: Urinalysis, hæmogram, Paul Bunnell, E.S.R., and chest films showed no abnormality. Smears from Stensen's ducts showed no malignant cells.

Treatment: Distaquaine Penicillin 300,000 I.U. twice daily for one week.

May 31.—Swellings slightly larger, otherwise symptomless.

Operation: (1) Open biopsy of the left upper cervical swelling; (2) Removal of small node from the left anterior cervical triangle.

Pathological Reports: (1) Normal parotid salivary tissue; (2) Lymphoid tissue containing salivary-gland tissue.

June 20.—Discharged to sick leave and out-patient follow-up.

Sept. 16.—Re-admitted to the Royal Naval Hospital, Chatham. No other symptoms or signs. General health good.

Examination: Swellings a little larger and now partly cystic on the left side. Regional and systemic examinations, chest films, and E.S.R. showed no abnormalities.

Provisional Diagnosis: Bilateral adenolymphomata of the parotid salivary glands.

Sept. 19.—

Operation: Excision of the left upper cervical swelling under general anæsthesia. A softish, partly cystic, well-defined, and encapsulated tumour (6 × 4 × 4 cm.) was easily dissected out from between the postero-inferior border of the left parotid gland and the anterior border

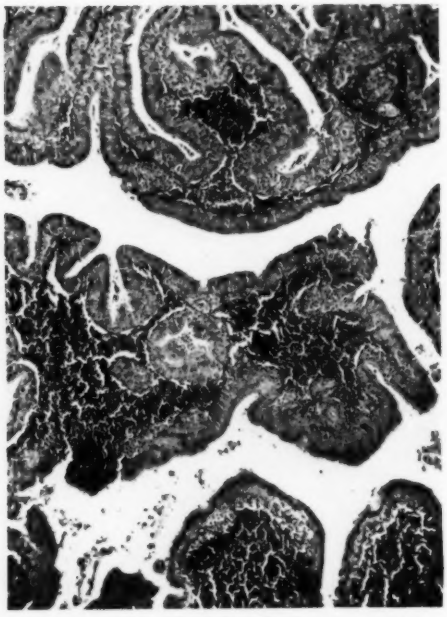

FIG. 569.—*Case* 2. Detail of predominantly epithelial area, showing the characteristic structure and epithelial-cell pattern of adenolymphoma. H. and E. (×42.)

FIG. 570.—*Case* 2. Tubercles within the lymphoid stroma of the adenolymphoma. Note glands. H. and E. (×36.)

FIG. 571.—*Case* 2. Discrete caseating tubercle surrounded by distended glans of the adenolymphoma. H. and E. (×36.)

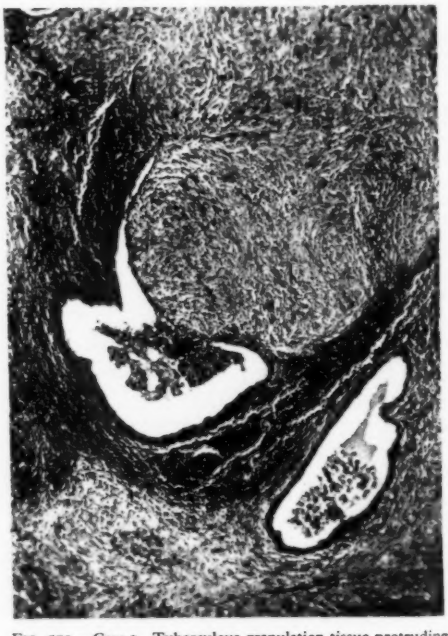

FIG. 572.—*Case* 2. Tuberculous granulation tissue protruding into lumen of gland. H. and E. (×35.)

of the left sternomastoid muscle. Small deep extension to the carotid sheath dissected free without difficulty.

Oct. 4.—

Operation: Excision of the right upper cervical swelling under general anæsthesia. A similar though smaller tumour (4·5 × 3 × 3 cm.) was excised from an

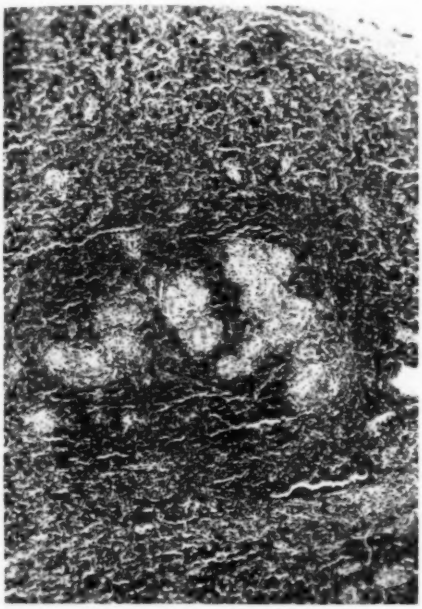

FIG. 573.—Heterotopic salivary-gland tissue in discrete cervical lymph-gland of *Case* 2. H. and E. (×45.)

identical anatomical location on the right side. An additional very small almond-sized tumour separate from the main mass and just within the substance of the posterior border of the right parotid gland was also removed.

Pathological Report: Sections of both tumours show characteristic features of adenolymphoma (*Fig.* 569). The epithelial elements are best seen in certain subcapsular areas where the growth has a papillary structure with little stroma. Here the regular layers of tall columnar non-ciliated cells with pink-staining cytoplasm and the second layer of small, irregular, basal cells are typical of adenolymphoma. In other parts there are cystic spaces separated by densely packed lymphoid stroma, also present in the papillary areas.

The whole tumour on the left side is studded with characteristic tubercular nodules (*Fig.* 570), some containing giant cells which are, however, not numerous. There is central caseation in many of the tubercles (*Fig.* 571). The subcapsular parts contain densely packed tubercles and there is very little glandular tissue to be seen.

In the central parts a tubercle may be seen lying in the stroma separating the glandular spaces (*Fig.* 571) or in the wall of a gland protruding into its lumen (*Fig.* 572).

There are a few lymphoid follicles with germinal centres especially in the right-sided tumour that shows no evidence of tuberculosis.

Acid-fast bacilli could not be demonstrated. A small lymph-gland removed at operation included a good deal of normal salivary-gland tissue, but showed no evidence of tuberculosis (*Fig.* 573).

Oct. 10.—Healed and discharged to duty. For out-patient follow-up.

DISCUSSION

The first case is of interest since it presented a problem in the differential diagnosis of a left-sided upper cervical swelling which was present at the same time as a small early carcinoma of the left external auditory meatus. In view of the past history of right-sided adenolymphoma and the length of history and clinical features of the left-sided swelling, a provisional diagnosis of left-sided adenolymphoma was made without aspiration biopsy and the tumour removed by local excision.

The apparent failure of response on the part of the adenolymphoma to irradiation of the left ear and neck fields emphasizes the ineffectiveness of this method of treatment.

In other respects this case is characteristic. The patient was a middle-aged male, both tumours were found in the same typical position bordering the tail of the parotid gland, and both were of average size with similar well-developed histopathological features.

The principal reason for this report centres around the findings in the second case, and in both cases considered together. There were in this latter patient at once several unusual features. He was younger than is usual and there was an emphatic history of very rapid, painless enlargement of both tumours over a 24-hour period. He was an intelligent witness and quite definite about the time period, although it is certain that the tumours must have been present for a considerable time previously and that the patient's attention was only drawn to them by their sudden dramatic enlargement.

The rapid enlargement and the age of the patient led at first to a provisional diagnosis of lymphadenitis or lymphoma rather than bilateral adenolymphoma, and as it was found on histology that the left-sided tumour was the seat of active tuberculous infiltration, the former diagnosis was at least in part correct. Unfortunately acid-fast bacilli could not be isolated by smear or culture of the creamy purulent fluid obtained from either tumour, nor was it possible to identify tuberculous foci in the stroma of the right-sided tumour despite otherwise identical appearances even to the finding of a similar creamy caseous type of fluid in the cystic spaces.

The only record of the successful observation of tubercle bacilli so far reported is that of Collins and Shucksmith in 1953, although there have been two other very convincing accounts of tuberculous adenolymphoma diagnosed histologically (Owen, 1946; and Hevenor and Clark, 1950).

Caseating tuberculosis within the tumour was certainly a very likely cause of the sudden enlargement of one side at least, and in fact a similar history of rapid swelling is given in one of the only other three accounts of active tuberculosis in the lymphoid stroma (Owen, 1946).

An additional small and quite separate tumour was found close to the main mass, but discretely situated within the parotid fascial envelope. A small discrete lymph-node contained groups of mucus glands and tubular ducts within the lympoid tissue of the node.

Collins and Shucksmith (1953) claim that any association at all between adenolymphoma and tuberculosis must reasonably be accepted as evidence in favour of a lymph-node origin for these tumours. They base their argument upon the facts of the rare

occurrence of true salivary-gland tuberculosis, the uncommon finding of adenolymphoma among parotid neoplasms, and the relatively common but separate occurrence of salivary tissue or tuberculous follicles in lymph-nodes of the parotid region. We would like to offer strong support for this conclusion by the findings in *Case* 2. We would go further and suggest in agreement with others (Wheelock and Strand, 1954) that many of these tumours

Table II.—BILATERAL ADENOLYMPHOMATA

AUTHOR	YEAR	CASES REPORTED	ALSO WITH MULTIPLE TUMOURS
Nino	1941	1	0
Plaut	1942	1	0
Ramage, Binnie, and McCall	1943	1	1
Lederman	1943	1	0
Martin and Ehrlich	1944	3	2
Kiaer	1948	1	0
Lawrence and Procita	1948	1	1
Wheelock and Madden	1949	1	0
Hampson and McNaughton	1952	2	0
Tanake and Chen	1953	1	0
Foote and Frazell	1953	6*	0
Thornton, Hennigar, and Kay	1954	1	1
Viikari	1957	1	0
Greeley, Gleason, and Curtin	1958	1	0
Shaw and Friedmann	1959	2	1
TOTAL		21	6

* Includes those reported by Martin and Ehrlich (1944).

have the characteristics both of an inflammatory and a neoplastic process. And it is certainly very probable that the rapid development and the fluctuations in size of some reported tumours may be due to lymphoid hyperplasia provoked by inflammation, either non-specific or specific. It is also possible that inflammation alone, especially if prolonged, may

Table III.—MULTIPLE ADENOLYMPHOMATA

AUTHOR	YEAR	CASES REPORTED	NUMBER AND LOCATION OF TUMOURS
Ramage and others	1943	1	2 R. side
Martin and Ehrlich	1944	2	Multiple L. side. Multiple and bilateral
Lawrence and Procita	1948	1	4 R. side
Salviati	1950	1	2 L. side
Hambury and Williams	1951	1	3 L. side
Thornton and others	1954	1	Multiple one side
Shaw and Friedmann	1959	1	2 R. side
TOTAL		8	OVER 13

itself promote neoplastic changes. Therefore one can reasonably postulate that such inflammatory changes may stimulate epithelial proliferation in these already adenoidal lymph-nodes. It may be interesting in this connexion to refer to the frequent association of the tumour with ear disease, which may, however, be incidental (*Table I*).

The interesting plurality of adenolymphoma as exemplified by their reported bilateral occurrence and multiplicity (*Tables II, III*) may also be taken as strong circumstantial evidence in favour of their lymph-node origin, since the multiple finding of even the relatively common benign mixed salivary tumour of the major salivary glands is exceedingly rare as a primary event (Frazell, 1954).

Moreover, if the theory of their histogenesis in adenoidal parotid lymph-nodes be accepted, it seems very probable that the high rate of recurrence found by Frazell in the Memorial Hospital series (12·2 per cent compared with 4·8 per cent for benign mixed salivary tumours receiving initial surgical treatment) can best be explained by the development of new adenolymphomata in the locally affected nodes. Therefore in the light of some increasing evidence of the plurality of these tumours, careful search should always be made at operation for such clinically inconspicuous satellites.

Finally, it is readily conceded that the accurate clinical diagnosis of all tumours in the parotid region is a difficult exercise (*Table I*). It has even been stated by Patey and Hand (1952) that a rate of 50 per cent incorrect clinical diagnoses was found among their own patients. But the occurrence of a circumscribed, often partly cystic, mobile, and probably non-tender swelling in the parotid region of a middle-aged male patient, especially if bilateral, and one which may be variable in size and consistency, or even rapidly enlarging, should cause the surgeon to suspect strongly the presence of adenolymphoma. He should attempt to obtain proof of the diagnosis by aspiration biopsy, and then proceed by simple exposure and enucleation of the mass if it appears to lie superficial or peripheral to the parotid salivary gland, as are the majority of parotid lymph-nodes. However, if the tumour is found to lie deeply within the substance of the parotid gland, or if on exposure of the gland the provisional diagnosis is in error, the operator must be prepared to carry out subtotal parotidectomy with facial nerve exposure and preservation, or more radical procedures.

SUMMARY

Two new patients having bilateral adenolymphomata are reported. In one patient the tumours were homolaterally multiple. A large single tumour on the left side revealed tuberculous foci in the lymphoid stroma.

The facts of tuberculous involvement, bilateral occurrence, and multiplicity of the tumours are taken as evidence to support the theory of histogenesis from adenoidal parotid lymph-nodes.

A plea is made for attempts at greater accuracy in the clinical diagnosis of swellings in the parotid region especially in view of the wider range of effective methods of surgical treatment now in use.

Acknowledgements.—Mr. R. Vaughan Hudson and Mr. Wallace Black have kindly supplied much useful information regarding *Case* 1. We are most grateful to Mr. D. J. Connolly for the photomicrographs.

Much gratitude is due to Surgeon Rear-Admiral D. Duncan, R.N., and the Medical Director General of the Royal Navy for kind permission to publish the records of *Case* 2 and to Surgeon Commander P. B. Nicoll, R.N., for the pathological material of *Case* 2.

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A CASE OF METASTATIC CARCINOMA OF THE ILEOCÆCAL VALVE PRESENTING AS A PRIMARY GROWTH

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BLOOD-BORNE metastatic tumours of the intestines are rare, and the following case report of a blood-borne metastasis in the cæcum from a primary neoplasm of the cervix was considered worth recording.

The metastasis occurred at the ileocæcal valve, and 'tertiary' deposits in the regional lymph-nodes draining this area were found. Presumably the route of spread was via the blood-stream, but there was no evidence of metastases elsewhere at the time of operation, nor was any local recurrence discovered. The patient presented with a mobile mass in the right iliac fossa and, both before and at operation, was thought to be suffering from a primary carcinoma of the cæcum. Right hemicolectomy was, therefore, done, and the patient made a satisfactory immediate recovery. Unfortunately, seven months later she developed evidence of spinal metastases.

CASE REPORT

A female patient, aged 65 years, was admitted on July 25, 1957, complaining of abdominal pain. Her appendix had been removed twenty years previously. Seventeen years ago, whilst living in India, she had had a subtotal hysterectomy for uterine fibroids. Sixteen months ago she was treated elsewhere for a squamous epithelioma of the cervix (Stage II). Following radium inserts, and a three-week course of high-voltage radiotherapy, a good response was noted and follow-up visits showed no recurrence of the neoplasm.

One month before admission she developed attacks of colicky right-sided abdominal pain, with a feeling of distension and nausea after eating. Her motions became loose and light brown. Examination showed a well-preserved woman with no clinical evidence of anæmia. There was no abnormality in the respiratory, cardiac, or nervous systems. A hard, irregular, mobile mass, the size of a fist, was palpable in the right iliac fossa. Well-healed right paramedian and lower midline scars noted.

Pelvic examination, later repeated under anæsthesia, showed no recurrence of the carcinoma of the cervix. Investigations were: Hb 99 per cent, W.B.C. 4900/c.mm., and normal differential count. The E.S.R. was 10 mm./hr. Stools contained no red cells, pus cells, amœbæ, cysts, ova, or parasites, and no occult blood was detected.

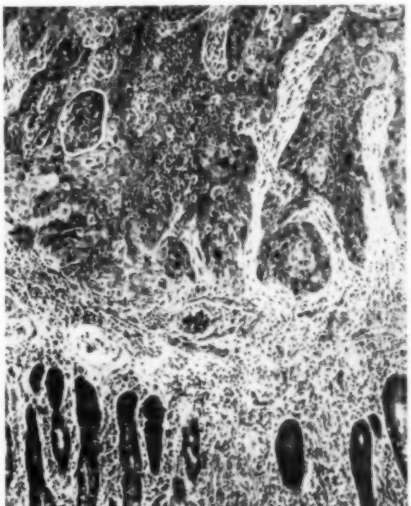

FIG. 574.—Showing squamous and horny carcinoma cells in the submucosal layer of the cæcum. (× 68.)

Barium enema revealed multiple diverticula in the pelvic colon. The cæcum could not be filled. Follow-through examination showed dilatation of the intestine proximal to the cæcum, and filling defects were present in the cæcum and terminal ileum, with destruction of the mucosal pattern. A chest radiograph was clear.

AT OPERATION.—Laparotomy was performed on Aug. 20. A large, hard, nodular mass in the cæcum was found with a smaller mass in the lymph-nodes of the ileocæcal angle. There was no evidence of metastases in the liver or elsewhere in the peritoneal cavity, including the pelvis. The mass was thought to be a primary carcinoma of the cæcum, and right hemicolectomy was done. The patient made an uneventful recovery.

The specimen showed an ulcer with everted edges, ½ in. in diameter, at the site of the ileocæcal valve, which was largely destroyed. The orifice was reduced to the size of a pin-hole, and as a result of the obstruction the ileum was hypertrophied and dilated to twice its normal size over a length of about 18 in. The growth had not extended into the ileum. The main spread had occurred in the submucosal and, to a lesser extent, in the muscular coats over an area of about 1½ in., but had not penetrated the serosa. Lymph-nodes in the ileocæcal angle were replaced by solid growth forming a mass ¾ in. in diameter.

Histological Report.—"Secondary squamous and horny carcinoma arising in the submucosa of the ileocæcal valve (*Fig.* 574). 'Tertiary' deposits in one of two upper most mesenteric glands, but not in four others or in the highest along the ileum; a considerable mass in the ileocæcal mesentery outside glands."

DISCUSSION

The spread of malignant neoplasms to part of the intestinal tract is a common occurrence. In many cases this is due to transperitoneal spread after the primary growth has erupted through the serosa. In advanced cases the spread may involve all coats and even cause ulceration of the mucous membranes. Sometimes lymphatic permeation in the serosa completely encircles the intestine, stenosing it in one or more places, and again giving rise to the impression that these are blood-borne metastases. Blood-borne metastases in the gut are, however, surprisingly rare. After excluding direct spread from adherent contiguous primary or secondary tumours, lymphatic permeation, and transperitoneal spread, Willis (1952) was able to find only 121 necropsy cases of blood-borne metastases to gut in the literature. In the majority of these cases there was widely disseminated hæmatogenous spread to many organs. In this connexion it is of interest that the liver was free of metastases in over half of these cases. The metastases to the gut were usually multiple, and of 102 cases in the literature where the number was recorded there were single metastases to the gut in only 18 cases. In 500 necropsies performed by Willis himself, discrete blood-borne metastases were found in the intestine in 10 cases, and in only 1 of these was the metastasis in the gut single. Four cases of metastases to the ileocæcal valve are recorded. Thomson (1899) records a case secondary to a malignant melanoma which produced, as in the case reported here, a palpable abdominal mass. Both in this case and in those reported by Church (1869), Israel (1897), and Willis himself (1931) there were multiple metastases. The high proportion of bowel metastases resulting from primary malignant melanomas recorded in the literature is noteworthy.

A number of cases originating from a primary carcinoma of the uterus have been described. Frank (1922) reported a strikingly similar case to the one recorded here. His patient developed a carcinoma in the cervical stump following an earlier supravaginal hysterectomy for fibroids. Seven months later she died after an operation for intestinal obstruction due to bands, and autopsy showed an isolated blood-borne metastasis in the appendix, although recurrent growth was present elsewhere. Sanchez San Julian, Pascual y Megias, Clavero Margati, and Llorca Lledo (1952) report a solitary blood-borne metastasis in the small gut from a previously treated carcinoma of the uterus. This was resected, but the patient died.

Blood-borne bowel metastases frequently present with intestinal obstruction. This may be due to narrowing of the lumen, as in the case reported here, or to intussusception. The latter complication occurs particularly where metastases have formed pedunculated tumours protruding into the lumen of the gut. In 2 of the 4 cases reported by Willis (1931), intussusception was found at autopsy, two intussusceptions being present in one of these cases.

Miller, Cucolo, and Hearn (1949) reported an ileocolic intussusception resulting from metastases secondary to a primary testicular carcinoma. The patient died shortly after gut resection. Occasionally the diagnosis may cause difficulty, as in 2 cases reported by Barand and Elliot (1930), where intestinal obstruction from blood-borne bowel metastases occurred before the primary growth in the lung had revealed itself.

The distribution of metastases in different parts of the gut is not uniform. Where multiple metastases in the gut are present, it is found that they are most numerous in the jejunum, gradually diminishing in number from there to the rectum.

Histological examination shows that the earliest growths occur in the submucosa. From there spread occurs both through the mucous membrane and the muscularis. Either an ulcerated lesion or a pedunculated outgrowth into the lumen of the gut may be produced. Spread occurs laterally, particularly in the submucous and later in the subserous planes. Tertiary spread to regional lymph-nodes may occur as in the case reported here. The naked-eye appearance was indistinguishable from a primary carcinoma.

SUMMARY

A case of a blood-borne metastasis to the ileocæcal valve simulating a primary carcinoma of the cæcum is described.

I would like to thank Mr. E. C. B. Butler and Dr. R. R. Bomford for permission to publish this case; and Professor Dorothy Russell for the report on the pathological specimen; also Professor Dix for his helpful criticism.

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A STUDY OF THE INCIDENCE AND TREATMENT OF BURNS IN A GENERAL HOSPITAL

By J. W. GOODFELLOW

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A GREAT deal has been written in recent years concerning the incidence, prevention, pathology, and treatment of burns and great advances in the management of these common injuries have taken place during this period. The following study was undertaken to assess the efficiency of present-day methods of treatment and the results obtained over a period of fifteen years. Especially has an effort been made to evaluate the types of local therapy commonly employed.

Material.—The method used has been to examine the records of 402 burned patients admitted to the beds of the Accident Service of the Radcliffe Infirmary, Oxford, during the period 1942–1956. These patients were admitted primarily for the treatment of their burns and they underwent their entire treatment at the Radcliffe Infirmary and the Plastic Surgery Unit at the Churchill Hospital.

No selection has been employed other than the exclusion of those cases where the notes were inadequate or where more than three days elapsed between burning and admission.

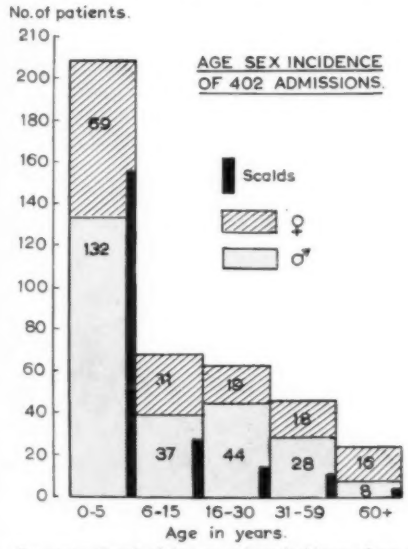

FIG. 575.—Graph of the age and sex incidence of 402 admissions. The graph also shows the number of patients scalded in each group.

Age, Sex, Type, Cause.—*Fig.* 575 shows that the majority (67 per cent) of the burned patients needing admission were under 16 years old. Half of the patients were under 6 years old, and *Fig.* 576 shows the age incidence in detail for this group. Colebrook and Colebrook (1949) found an almost identical pattern.

The children were injured, almost without exception, in their homes. Of the under sixteens 68 per cent were scalded and the percentage is higher still in the under sixes (78 per cent) (*see Fig.* 575). It appears, therefore, that despite the great publicity which they have been given the dangers, to the young child, of the kettle, the teapot, and the hot bath are still not sufficiently realized.

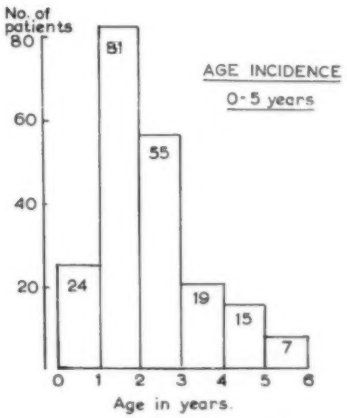

FIG. 576.—Age incidence of those admitted under 6 years old.

In this series 249 patients were male and 153 female and *Fig.* 575 shows the sex ratio in each group. Colebrook and Colebrook (1949) found a similar sex incidence in young children (male 3 : female 2) and noted a heavier case mortality among females, which they attributed to the greater severity of injuries resulting from burning clothes, to which the female child is more prone. No explanation has been offered for the male preponderance, which is most marked in the group under 5 years old. The female preponderance at the other end of life is no doubt related to female longevity.

Surface Area Burned.—From *Fig.* 577 it appears that burns of more than 20 per cent of the body's surface were uncommon at this centre, representing only 12 per cent of those admitted, whereas at the Burns Unit at Basingstoke, to whose care severely burned patients are transferred from surrounding hospitals, this group represented 21 per cent of the patients admitted in recent years (Evans, 1957).

TREATMENT

Shock.—It is to the better understanding of the nature of burns shock and to its rational therapy that we owe, in large measure, the improved mortality figures of the last decade. None the less, despite these advances, nearly half the fatalities in the present

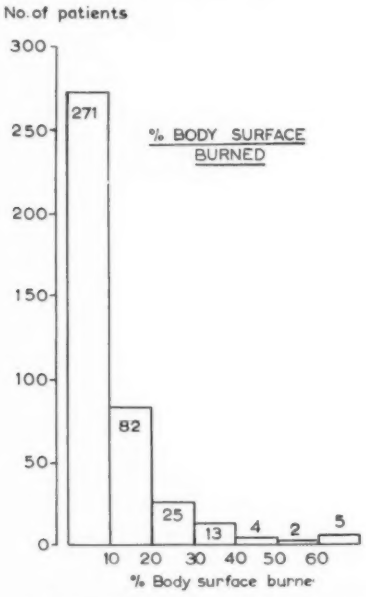

FIG. 577.—Percentage body surface burned in 402 in-patients.

series were directly attributable to shock (*see below*). The ideal local treatment, that is, limitation of plasma loss from the burned surface, has not yet been attained, but the immediate replacement of adequate amounts of plasma to the depleted circulation has proved its value. We could find no reliable evidence that any of the methods of local treatment yet devised significantly decreases the volume of exudate, although both pressure dressings and exposure to the air may be partly effective in reducing plasma loss.

Tables constructed to give guidance on the quantities of plasma required, though often valuable, have not been found entirely adequate. One variable of which they take no account is the site of the burn. It has been our experience that the degree of shock which results from burns of special areas—for instance, the face and genitalia—often greatly exceeds that to be expected merely from a consideration of the surface area involved. In this hospital reconstituted dried plasma is used in the replacement therapy of partial thickness burns, the quantity given depending more upon frequent hæmatocrit and hæmoglobin estimations than upon the observed extent of the burn (Cram, 1951).

Blood transfusions have frequently been necessary at a later stage of treatment for the correction of anæmia, but in the period of initial resuscitation whole blood has only been employed in those patients who had suffered extensive deep burns.

There is some evidence that hæmoconcentration may be a factor in the causation of the delayed anæmia of burns. Thus Cameron, Burgess, and Trenwith (1946) induced anhydræmia by subcutaneous injections of hypertonic glucose in rabbits and goats and recorded a low colour-index anæmia. This suggests that the infusion of large quantities of whole blood during the stage of hæmoconcentration might, by maintaining a polycythæmic state, contribute to an eventual anæmia, perhaps through a depressant action on the marrow. A series of experiments in animals and in Man carried out by Abbott, Meyer, Hirshfeld, and Griffin (1945) seems, however, to refute this. Studying changes in the red-cell mass in burned dogs, they observed an anæmia in those that received plasma infusions, but no anæmia in those whose resuscitation was with whole blood. Furthermore, they showed that if the blood transfusion was delayed until the anæmia was established, i.e., at about the eighth day, it rapidly recurred. That immediate whole-blood therapy minimized the anæmia in human burns was shown by a comparison of two groups of severely burned patients treated with blood and plasma respectively.

Local Treatment.—The two methods most commonly employed in the immediate local treatment of burns are occlusive dressings and exposure to the air.

Occlusive Dressings.—The surface of a freshly inflicted burn is sterile and the intention in applying occlusive dressings is to exclude bacterial contaminants from without. Other possible sources of infection are the flora of the intact skin immediately surrounding the burned area, and the hair follicles and sebaceous glands in the burned area itself, in the depths of the crypts of which organisms may survive.

The ideal dressing, therefore, must not only exclude contaminants from without but must destroy or inhibit the growth of those already within.

The dressing fulfils the former function and remains impenetrable to bacteria only for as long as it can absorb the exudate from the wound, and should it become soaked its efficacy ceases. The latter function is fulfilled in part by the preliminary toilet and in part by the application beneath the dressing of some antibacterial substance.

This method of treatment has many drawbacks. Changing the dressing causes pain and may necessitate the administration of anæsthetics, with their attendant risks. Should contamination of the wound supervene the warm moist environment which the dressing provides will favour bacterial growth. Furthermore, the fixation of such dressings is difficult on many parts of the body and impossible on some.

Some advantages of the method over that of exposure discussed below are that limbs so treated may be splinted and elevated and the patient may be more easily transported.

Exposure.—In 1947 Wallace, of Edinburgh, re-introduced the practice of exposure of burns, first employed in the nineteenth century, and it was hoped that by this method the disadvantages inherent in occlusive dressings would be overcome and results improved (Wallace, 1949).

The aim of such treatment is to produce upon the burned surface, with as little delay as possible, a dry

and impermeable crust beneath which the processes of repair can go forward. This crust, therefore, takes the place of a dressing and should, for success, exhibit the properties of the ideal dressing.

The Methods Compared.—Examination of the literature has failed to provide a clear answer to the question of the superiority of either method. What evidence the literature affords is discussed below.

It has often been remarked that the single most important factor in the prognosis of the burned patient who has survived the period of initial shock is the presence or absence of infection. It was claimed for the method of exposure that the incidence of infection was reduced, and the frequency of this complication under the two régimes has been the subject of much investigation. Authors vary in their definition of the term 'infection' in relation to burns. Colebrook, Duncan, and Ross (1948) and Liedberg, Kuhn, Barnes, Reiss, and Amspacher (1954) employed the term in a bacteriological rather than a clinical sense and accepted the presence of any micro-organism on the burn wound as evidence of infection. The former employed the modified term 'silent infection' to imply the absence of clinical signs and symptoms.

Blocker, Blocker, Lewis, and Snyder (1951) made cultures from the dry sloughs of exposed burns and from the surfaces of burns treated by pressure dressings and found similar pathogenic organisms on both. Lowbury, Crockett, and Jackson (1954) also investigated the bacteriology of comparable burns treated by the 'open' and 'closed' methods and found a rather higher percentage of *Staph. aureus* and *Str. pyogenes* contaminants in the 'open' than the 'closed' group, while the opposite held for *Ps. pyocyanea* and *Bact. coli*. They felt that their results refuted the claims made for lower rates of infection in exposed burns. Employing the clinical criteria of fever, leucocytosis, and suppuration as evidence of infection, Artz, Reiss, Davis, and Amspacher (1953) found that 23 per cent of a group of patients suffering from partial-thickness burns and treated by exposure became infected, but that only 6 per cent displayed "frank suppuration". It should not be assumed, however, that contamination of a burn insufficient to give rise to these clinical signs of infection is always innocuous; indeed, there is evidence that such 'silent infection' can delay healing and interfere with the process of skin-grafting (Williams and Miles, 1949; Jackson, Lowbury, and Topley, 1951 a, b).

It appears, therefore, that in this very important respect the superior qualities of the method of exposure have not been proven and until the importance of contaminants is known no satisfactory comparison between methods of treatment can be made from the bacteriological standpoint.

Rousselot, Connell, and Whalen (1953) recorded their opinion of the method of exposure that "there is a marked diminution in hospital stay of patients treated by this method", but they made no direct comparison of groups of patients treated by the alternative methods.

Hay and Cronin (1954) compared the average hospital stay of three groups of patients treated by saline dressings, pressure dressings, and exposure respectively. They found the in-patient period in the latter group somewhat shorter than in the other two, but they provided no evidence that the groups were comparable in other respects.

Blocker and others (1951) compared two groups of patients (54 treated 'closed' and 39 'exposed') and found a markedly shorter average hospital stay in the latter group. These groups were comparable in respect of the extent of their burns.

We feel that the most satisfactory criteria upon which a comparison of methods of treatment can be based are: (1) in-patient period; and (2) the period to complete healing. Bacterial contamination, in so far as it is deleterious, will be reflected in prolonged healing times, whereas contaminants, in so far as they are innocent, will not delay healing and will not therefore be accorded undue significance.

Table I.—Results of Treatment in 374 Survivors

Body Surface Burned	*Average Days in Hospital*	*Average Days to Complete Healing*	*Number of Patients*
per cent			
0–10	20·9	31·3	270
10–20	39·7	47·4	78
20–30	68·8	85·8	19
30–40	47·5	48·1	6
40–50	141	141	1
All patients	28	38	374

This is not to say that other criteria less susceptible of exact analysis can be ignored. The comfort of the patient under the two régimes, the possible systemic effects of the local measures, the eventual cosmetic results, etc., warrant consideration.

However, accepting the in-patient and healing times as significant, the main factors other than local treatment influencing those times must be sought.

They are:—

Severity of Burn.—This is dependent on the depth of tissue burned and the surface area affected. It has proved impossible from the available records to assess with any certainty the depth of most of the burns, and therefore the percentage body surface area burned has been accepted as the index of severity. *Table I* shows the correlation which exists between surface area burned, and in-patient and healing times in 374 patients who survived. Other series show a similar relationship (Hay and Cronin, 1954).

Site of Burn.—Both the infection rate and the type of infecting organism differ in different parts of the body (Lowbury, Crockett, and Jackson, 1954) and such variations may be expected to affect the healing times. Furthermore, in those areas where hair follicles or sweat glands penetrate deeply into the skin—i.e., scalp, face, palm, and sole—regeneration without skin-grafting may occur following burns of sufficient severity to destroy all layers of the skin of other areas (Jackson, 1953).

General Health of Patient.—Old age, coexistent illness, anæmia, and hypoproteinæmia all delay healing.

Any attempt at comparison of groups of cases treated by the open and closed methods must therefore exclude as far as is possible variations due to these other factors.

In the paragraphs that follow the term 'closed' treatment is used to denote the application of an occlusive dressing, of whatever sort. During the period under review a great variety of ointments and creams has been applied on an equally varied selection

of dressing materials and no attempt is made here to assess the relative virtues of these substances or to particularize beyond describing them all as 'closed' treatment.

The term 'open' treatment denotes here the exposure of the burned area, after preliminary toilet

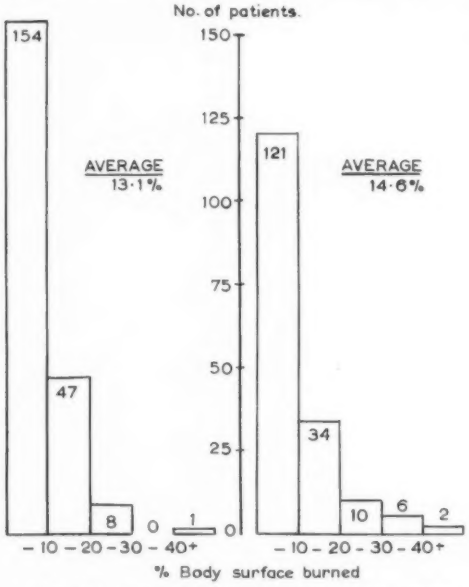

FIG. 578.—The graphs show the percentage body surface burned in the two groups of patients compared in *Table* II. The graph on the left is of the patients treated by occlusive dressings, that on the right of those treated by exposure.

to the open air. It has been our practice to insufflate the exposed burns with a mixture of penicillin and lactose powder until a dry surface is obtained.

ANALYSIS

1. *Table II* shows the healing times and in-patient times for two groups of patients: Group I, treated between the years 1942–1952 inclusive; and Group II, treated between 1953–1956 inclusive. In Group I

Table II.—A COMPARISON OF RESULTS IN TWO GROUPS OF PATIENTS: GROUP I TREATED 1942-1952; GROUP II TREATED 1953-1956

	Average Days in Hospital	*Average Days to Complete Healing*	*Number of Patients*
Group I	26	36·6	195
Group II	29	39·5	179

most of the patients were treated by the 'closed' method whatever the site or extent of their injury. In the latter period most patients were treated by the 'open' method when applicable. These figures suggest that recent changes in the methods of treatment have not materially altered the course of non-fatal burns.

2. In an attempt further to elucidate the effects of local treatment the results for all 'open' and all 'closed' burns in this series were compared. Where a patient had been treated by both methods simultaneously for two burned areas these were considered as separate burns.

That these two groups were comparable in respect of the extent of the burns is shown in *Fig.* 578. The results are compared in *Table III.*

However, in the above comparison the groups differed in respect of the site of burning, for the extremities have in the past been treated most often

Table III.—A COMPARISON OF RESULTS IN TWO GROUPS OF PATIENTS TREATED BY OCCLUSIVE DRESSINGS AND EXPOSURE RESPECTIVELY. BURNS OF ALL AREAS

Method of Local Treatment	*Average Days in Hospital*	*Average Days to Complete Healing*	*Number of Burns*
Occlusive dressings	27·6	29·7	210
Exposure	30·5	34·7	173

by occlusive dressings while burns of the face and trunk have more usually been exposed.

3. *Table IV*, showing the results of 120 patients whose burns were limited to the arms, legs, hands, and feet, suggests that for burns of these areas the

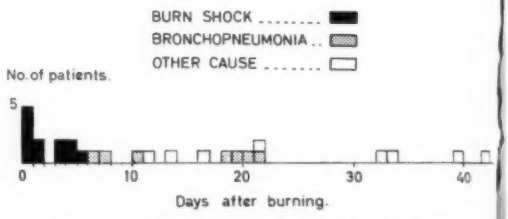

FIG. 579.—The time and cause of death in 27 fatal burns.

method of local treatment employed has little effect on the healing time, but that the period of hospitalization is significantly less when occlusive dressings are used.

Mortality.—There were 28 fatalities among the 402 patients, a mortality of 6·9 per cent. *Fig.* 579 shows the period which elapsed between burning and death in each case and also the cause of death. One patient who died 150 days after injury with bronchopneumonia is not included. Among the 'other

Table IV.—A COMPARISON OF RESULTS IN TWO GROUPS OF PATIENTS TREATED BY OCCLUSIVE DRESSINGS AND EXPOSURE RESPECTIVELY. BURNS OF LIMBS

Method of Local Treatment	*Average Area Burned*	*Average Days in Hospital*	*Average Days to Healing*	*Number of Patients*
	per cent			
Occlusive dressings	5·4	21·6	39·5	99
Exposure	8·2	35·0	37·6	21

causes' of death, not specified there, were cardiac failure (2), post-operative shock after skin grafting (2), and renal failure (1). In 2 cases the cause of death could not be ascertained. There was only 1 fatality which could be attributed directly to infection, this being the case of a female child aged 1 year who died 43 days after burning, with a mixed *Ps. pyocyanea* and *Staph. aureus* infection of her extensive burns. It is interesting that in this series there was not one

fatality from a fulminating streptococcal or staphylococcal burn infection. These findings contrast strikingly with those of Artz and Soroff (1955), who studied the records of 53 fatalities among over 800 patients admitted to hospital and found that septicæmia accounted for more than half the deaths.

Conclusions.—The great importance, both economic and humane, of the 'minor' burn is shown by the figures given above. In all, save the aged, burns of less than 20 per cent of the body's surface have a negligible mortality under the present régimes of treatment. These injuries are, however, the cause of prolonged morbidity and hospitalization, expensive both to the State and to the patient. There is general agreement that early skin-grafting, performed as soon as the extent of the full skin thickness loss can be ascertained, is a most important factor in hastening healing. Of the last 100 cases treated at the Radcliffe Infirmary one-third of the burns of less than 10 per cent body surface and over one-half of the more extensively burned patients were grafted.

The relative values of the methods of initial local therapy are, however, still in dispute. Primary excision and skin-grafting is of undoubted value in a small number of patients who have received deep circumscribed burns. In only 8 of the patients here reviewed was it employed. Of the other methods of local treatment we favour the application of an occlusive dressing and immobilization with plaster-of-Paris splints for burns of the extremities. This method we find most effective in the prevention of deformity and we believe that the results presented above confirm that such treatment allows the patient to leave hospital significantly earlier than is the case when burned limbs are treated by exposure.

Burns of the face and trunk are best treated by the method of exposure because splintage is unnecessary and satisfactory dressings cannot be easily applied. The method solves many nursing problems and simplifies treatment, but our experience provides no evidence that its introduction has shortened hospital stay or reduced healing times.

SUMMARY

The age incidence, sex incidence, and extent of injury of 402 burned patients is presented.

Methods of general and local treatment are discussed and the results in groups of patients treated by occlusive dressings and exposure to the air are compared.

The cause and time of death in 28 fatalities are given.

Acknowledgements.—My thanks are due to the staff of the Accident Service of the Radcliffe Infirmary for access to their cases, and especially to Mr. J. C. Scott, Director of the Accident Service, for his helpful criticism and advice.

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TRAUMATIC CLOSED RUPTURE OF THE UPPER URETER

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IN a Hunterian Lecture Morris (1908) could find only 3 proved cases of rupture of the ureter in the literature. Hamilton Bailey (1924), in a 20-year review of the London Hospital records, reported another undoubted instance where the ureter was avulsed from the renal pelvis. The injury was a post-mortem finding in association with other visceral damage.

Even two World Wars have only added a few cases: Hughes and Banks (1919) 8 cases; American Expeditionary Force Records (1927) 4 cases; Everidge and Barnes (1946) 3 cases.

The majority of these cases are associated with penetrating wounds with or without injury of other abdominal viscera.

By virtue of its protected position and the comparative thickness and elasticity of its wall, the ureter is less liable to damage by violence than any other abdominal structure.

The present case is regarded as of sufficient interest to be added to those already recorded.

CASE REPORT

The patient, a boy aged 3 years, was admitted to the Royal Northern Infirmary on the morning of May 1, 1957, soon after having been knocked down by a van. He had not been unconscious, but was dazed and suffering from slight shock. There were numerous abrasions on the face and head and both hands. Bruising was noticed on the left lower abdomen, left loin, and sacral region. There was no evidence of intra-abdominal injury. Radiological examination revealed a fracture of the left pubic bone with slight displacement. He was considered to have (1) multiple bruises; (2) mild concussion; (3) fracture of left pubis; and treatment was expectant.

The following day he was much better but still rather irritable, and had not passed urine. Although there was no clinical evidence of visceral injury, he was catheterized and 2 oz. of normal urine removed. Later that day he voided spontaneously and over the next few days he rapidly improved. The fractured pelvis was treated by bed rest for a further 4 weeks and he was discharged on June 22, apparently fully recovered, after just over 7 weeks in hospital.

Two weeks later he was referred to the Pædiatric Clinic, Raigmore Hospital, because his mother noticed that he had been passing blood-stained urine for three

FIG. 580.—Intravenous pyelogram.

FIG. 581.—Right retrograde pyelogram.

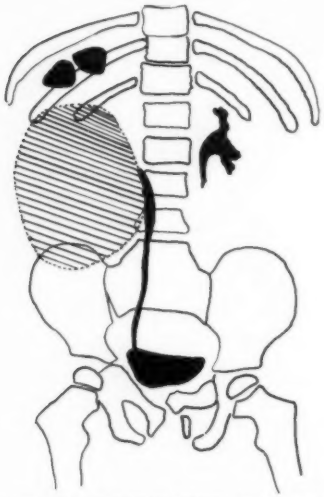

FIG. 582.—Drawing combining features of *Figs.* 580 and 581, with operation findings added.

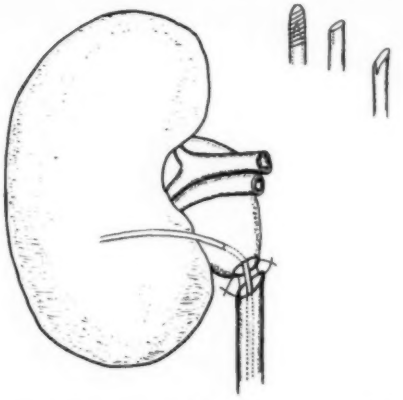

FIG. 583.—Operative procedure. *Inset*: shows method of enlarging ureteric lumen.

days. She also observed that his abdomen was fuller than usual. He had complained of abdominal pain on two occasions, lasting about one hour.

On examination he looked healthy. Abdominal examination revealed a swelling in the right lumbar region extending from the costal margin to the iliac fossa and reaching almost to the midline. It was smooth, firm, and fixed.

Urine Examination: Trace of albumen, moderate No. R.B.Cs.

Blood-urea: 36 mg./100 ml.

Intravenous pyelography (*Fig.* 580) ten weeks after the accident showed the right kidney to be functioning very poorly and only from the upper pole, the calices being hydronephrotic. The renal shadow was displaced upwards. The left pyelogram was normal.

FIG. 584.—Intravenous pyelogram one month after operation.

On cystoscopy and retrograde pyelography the bladder and ureteric orifices were normal, but there was neither peristalsis nor efflux of urine from the right side. A catheter was easily passed up the right ureter for 15 cm. The radiographs showed that the ureter was displaced medially, and after injecting diodone only the ureter could be filled to the level of the 2nd lumbar vertebra (*Fig.* 581). As the excretion pyelogram had shown some renal function, exploration was decided on in the hope that the kidney could be preserved.

AT OPERATION (July 24).—The swelling was exposed through a lateral oblique muscle-cutting incision. It lay extraperitoneally deep to the transversalis fascia. In trying to find a plane of cleavage the thin wall was opened and 4–5 oz. of straw-coloured fluid escaped. This was subsequently shown to contain 0·5 per cent chloride and 0·3 per cent urea and to be sterile on culture.

Fig. 582 diagrammatically shows the information obtained from the excretion and retrograde pyelograms and the operation findings. The cyst wall was easily removed after the ureter had been freed from it. The ureter appeared to have been avulsed at the pelvi-ureteral junction and its torn end was found to be tapered and occluded. The kidney was then mobilized and examined. It was enlarged, but the cortex was healthy and its vascular pedicle was intact. The renal pelvis was tense and separate from the cyst.

Fig. 583 illustrates the operative procedure. A small incision was made in the most dependent part of the pelvis. The end of the ureter was then trimmed till the normal lumen was found. The lumen was enlarged by slitting the wall vertically (*see inset, Fig.* 583).

A polythene tube (0·5-mm. bore) was passed into the pelvis through a separate opening and guided down the ureter for 4–5 cm. to act as a splint and drain. A pelvi-ureteral anastomosis was fashioned around the tube, using interrupted 3/0 plain catgut sutures. The wound was closed, the polythene tube being brought out at its posterior end along with a corrugated drain for the renal space. The corrugated drain was removed on the fifth post-operative day and the polythene tube on the tenth day. The wound leaked dilute urine until the eighteenth post-operative day and thereafter healed soundly.

FIG. 585.—Intravenous pyelogram three months after operation.

An intravenous pyelogram was taken on the twenty-ninth post-operative day (*Fig.* 584). It showed a degree of hydronephrosis on the right side but with good concentration and the right ureter was also visualized.

He was then discharged.

Three months after operation a further pyelogram showed continued improvement in the size and shape of the renal pelvis and calices (*Fig.* 585). Concentration is normal. The urine is sterile.

A recent intravenous pyelogram performed eighteen months after operation is essentially the same as that illustrated in *Fig.* 585.

COMMENT

This case is an example of a closed injury of the upper ureter, the ureter having been avulsed from the renal pelvis. The escaping urine had become encysted, the wall of the cyst being of fibrous tissue. The renal pelvis must subsequently become sealed off from the cyst, as in *Fig.* 580 the dye is obviously not outside the caliceal system and this was confirmed by the operation findings. The retrograde pyelogram clearly demonstrated the presence of a

complete ureteric block. The repair was carried out twelve weeks after the injury, yet the recovery of renal function has been excellent.

Another point of interest was that the encysted collection of urine had remained sterile. The descriptions given in many text-books lead one to believe that infection invariably occurs where urine is extravasated.

The mechanism of the closed injury has been studied experimentally by Küster (1896). He considers that the lesion is produced by compression of the kidney and its pelvis against the 12th rib or upper lumbar transverse processes, with an additional factor of stretching the ureter by lateral flexion of the trunk. This explanation is supported by the fact that in most recorded cases the injury has been at or near the junction of the ureter and renal pelvis (Bailey, 1924).

In spite of the rarity of the injury it is interesting to note that the clinical features are well described in the text-books.

The treatment advised is nephrectomy, as all authorities state that repair is rarely practical, especially in a child; and, if carried out, surgical stricture is almost certain, with the subsequent development of hydronephrosis (Campbell, 1951).

These cases are so extremely rare that it is impossible to dogmatize about their correct treatment. If the encysted urine in this case had been infected it is open to question whether the anastomosis between the ureter and pelvis would have been so satisfactory. Nevertheless the success of this case would seem to justify an attempt to salvage the kidney even where the encysted urine had become infected.

I am indebted to Mr. A. J. C. Hamilton for his advice and helpful criticism in the preparation of this paper; and to Mr. C. Hunt for the photographs.

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'GREASE-GUN' INJURY

BY RICHARD HARRISON, LONDON

INJURIES to the hands, produced by the injection into them of fuel oil or lubricating grease under high pressure, are not new entities. Cases were described twenty years ago (Rees, 1937), and since then some two dozen examples have been reported. Discussion with colleagues, however, leads us to believe that these injuries are much commoner than this figure suggests. At the same time they are sufficiently unusual to perplex some of the surgeons called upon to treat them. Since the prognosis of these damaged hands is largely determined by the treatment they are accorded, it seems worth while to report a further typical case.

CASE REPORT

K. S., a man aged 27 years, a native of Jamaica, attended hospital on July 12, 1957, complaining of pain in the left index finger. Twenty-four hours earlier he had been lubricating a car in the garage where he was employed, with a high-pressure grease gun. One of the nipples he wished to inject was mounted on a loosely hanging brake cable, and he used his left hand to steady the cable whilst he held the gun with his right. The nozzle of the gun slipped as he pressed its trigger, and struck the back of the distal segment of his index finger. He experienced an immediate sharp pain, radiating from his finger, along the forearm. The skin of his finger was slightly torn, but did not bleed, and he was able to

FIG. 586.—The appearance of the damaged finger two weeks after injury

FIG. 587.—Appearance at operation.

continue his work. But that night the finger throbbed and he had very little sleep.

When the patient was first seen in a Casualty Department the following day, the nature of the injury was not appreciated. For some two weeks he was treated conservatively, and received several injections of penicillin. Then he was referred to an out-patient clinic for a further opinion. At that time the finger presented the appearances shown in the accompanying photograph (*Fig.* 586). It was discoloured, swollen at its base, and bore a small healing abrasion on the dorsal aspect near the nail. There was also some slight swelling of the back of the hand. The swollen tissues felt firm, but were not hot or markedly tender. No oil could be expressed from the skin lesion. There was a small area of hypo-æsthesia about this wound. The interphalangeal joints could be moved, actively or passively, through only a few degrees. The patient's temperature was not raised, nor did he complain of any systemic disturbance.

AT OPERATION (Aug. 12).—Under a general anæsthetic and with a tourniquet on the arm, the finger was opened along its mid-lateral line and a dorsal skin-flap reflected (*Fig.* 587). The subcutaneous tissues were found to be distended with a dark-brown gelatinous material which could not be wiped away, but which was easily separated by gentle scraping with a blunt curette. Some 2–3 c.c. of this oily material was removed from the finger, but when the incision was prolonged on to the dorsum of the hand a much larger quantity was found here and similarly removed. The operation area was then swabbed with ether, but this procedure did not appear to remove much more oil, or to alter the appearance of the tissues stained with the residue. The wound was sutured and a pressure dressing applied.

PROGRESS.—The operation wound healed well, and the patient, when examined on Nov. 19, had regained almost full movements of the finger. He could flex it to within a centimetre of the proximal palmar crease, but its dorsal aspect was slightly tender and there was some thickening of its skin, with slight keloidal changes in the surgical scar.

DISCUSSION

These injuries occur in two ways—commonly from a 'grease gun' of the sort used to spray lubricating oil on to automobile springs or to force it through the fine nipples on parts of a car chassis. The lubricant used for this purpose is a graphite and hydrocarbon mixture, specially prepared to resist hydrolysis and washing away. It is confined in a reservoir under pressures which vary between 150–200 lb. per sq. in. and is fed through a pipe line to the fine nozzle of the gun. The pressure under which it emerges from this fine orifice is, of course, very much greater and is measurable in thousands of pounds per square inch.

Injuries are usually sustained when the gun itself is being cleaned, or whilst it is being directed at a piece of machinery which is being steadied with the operator's other hand. An accidental pressure on the trigger will blow the grease into a finger or hand placed in front of the nozzle, even if it be several inches away from it. In the nature of things, the left hand is usually the one damaged (Sterling Bunnell, 1956).

Sometimes the injury is sustained during the servicing of a diesel engine (Rees, 1937). The injector mechanism of such an engine is essentially similar to the 'grease gun' described above, and there seems no great difference between the effects of lubricating oil and that of diesel fuel after injection.

Immediately after injury the damaged part feels numb and looks swollen. The entry wound is usually inconspicuous, with only slight skin damage and little or no bleeding. Within 24 hours the patient suffers severe pain, and the swelling may increase. At this stage the appearance of the hand suggests an acute infection, but its temperature is not raised. Untreated the condition may progress to a dry or a moist gangrene. If the tissues survive they may undergo an intense fibrous-tissue proliferation. Sinuses may form and will for several months discharge small beads of waxy material. The bones show some osteoporotic change and small fragments may sequestrate.

All those authors who have reported cases are agreed that the treatment of choice is early incision of the injected part, and the mechanical removal of as much grease as possible. This will often be found to have tracked widely, and the procedure sometimes yields a surprising amount. Sixty c.c. were removed by Hilton Smith (1939). On the other hand, the grease is often in a particulate form and it may be possible to scrape out only small quantities. Even so, operation is well worth while, and may be followed by an improvement—attributable to decompression—out of all proportion to the quantity of material expressed (Bell, 1952). Most writers mention the use of solvents such as ether, but where the grease, in particulate form, is not amenable to mechanical removal, solvents will not reach it either. Hot soaks are to be avoided, as increasing the metabolic demands of tissues which are already ischæmic. And where amputation is deemed necessary, it should be deferred for some time, since the eventual area of necrosis is often much less than the early appearances suggest.

In conclusion it should be pointed out that it is rather surprising that accidents of this variety do not occur more often. Few of the workers who handle grease guns realize the potential dangers associated with them. Posters about the hazard might well be displayed in garages, and the necessity stressed (Smith, 1939) for treating the nozzles of these instruments "with all the precautions applicable to the muzzle of a loaded rifle".

The author is indebted to Mr. J. C. R. Hindenach, who treated this case, for permission to report it, and to the Photographic Department of the Royal Free Hospital for the illustrations.

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RETROSTERNAL ARTIFICIAL ŒSOPHAGUS

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THE fiftieth anniversary of the operation of the creation of a subcutaneous artificial œsophagus from a jejunal loop was celebrated in 1957.

In 1907 Herzen, of Moscow (1908), was the first surgeon in the world to complete an operation for benign stricture of the œsophagus. His patient was a girl aged 20 years. The operation was carried out in three phases, spread over three months. At the first stage he transferred the upper part of the jejunal loop to the chest and at the second stage (after 29 days) he anastomosed it with the stomach and at the third stage (after 44 days) he connected it with the œsophagus in the neck.

It is known that Herzen performed his operation after the method of Roux, who, nine months earlier, had done the initial stage of this operation on a boy aged 11 years. Roux, however, delayed attempts at the second stage of the operation—the anastomosis in the neck—for a further four years (1911). Thus, the operation of artificial œsophagus fashioned from the jejunal loop quite properly bears the name of Roux-Herzen.

The successful outcome of Herzen's operation stimulated other surgeons in Russia and Western Europe to emulate his method, but for some years no further successful results were reported. By 1915, so far as can be ascertained, only four surgeons (Herzen, Lambotte, Roux, and Grekov) had successes to record by the Roux-Herzen procedure. Out of 22 operations performed by Russian surgeons up to 1930, 9 had ended in death. Eight of these patients had a complete or partial necrosis of the jejunal loop. Even now, after a score of years and hundreds of these operations have been successfully completed, there have been cases where the attempt to bring out the jejunal loop subcutaneously on to the chest has ended in necrosis. Nevertheless the technique of Roux-Herzen is still the most frequently practised method of mobilization of the jejunal loop before its transference by this or that way to the neck.

For years investigations have been proceeding to try to reduce the risk of necrosis which is the outcome of the stretching involved in the transference of a jejunal loop as high as the neck. Many surgeons have been working in this field. Amongst the most successful was S. S. Yudin (Moscow), who for twenty years—from 1928—persistently and successfully performed Roux-Herzen's operation. He improved the operation and performed it on more than 300 patients.

Developing Yudin's method in the Sklifosovsky Institute at Moscow in conjunction with Professor G. R. Hundadze, we have found a new and alternative way of bringing the jejunal loop with safety into the neck. The essence of this method consists in mobilization of the cæcum and of the root of the mesentery of the jejunal loop. The procedure is performed in the following way:—

The vessels of the mesentery of the selected loop are first divided and ligated and the loop is then drawn up as high as is possible without prejudicing the blood-supply by risking the suture of one more vessel. At this stage the cupola of the cæcum is raised and the parietal peritoneum along its outer side is divided. The cæcum can now be brought out into the wound and the dissection and mobilization proceed beneath the posterior leaf of peritoneum medially towards the spine. In this manner the root of the mesentery is freed and this makes possible its elevation together with the whole mass of associated jejunal loops. By this simple manœuvre a length of jejunum can be transferred, without risk to its vitality, 10–20 cm. higher than is possible by ligature of the mesenteric vessels alone.

We have performed this operation more than 150 times since 1949. We feel that the operation has been a success and it has been well received by other surgeons (Savinykh and Rogacheva, 1952; Popov, 1956; Kuzntezov, 1957; Roth, 1955; Gergely, 1954). Seven months after our publication, Dubost and Bernier (1950) also described the operation, using a similar technique. Throughout this period trials were being made of new ways to bring jejunal loops to the neck. The advantages and disadvantages of the subcutaneous and retrosternal routes will be discussed.

Subcutaneous Route.—Although the subcutaneous route is less risky than the retrosternal, it is not entirely satisfactory. With the development of chest surgery, opportunities for the intrathoracic reconstruction of the œsophagus occurred. These are: (1) Intrapleural; and (2) Retrosternal (through the anterior mediastinum).

The method of intrapleural reconstruction was developed first: by this method the jejunal loop is threaded through an opening in the diaphragm into the pleural cavity, where it is sutured to the œsophagus (Rienhoff, 1946; Yudin, 1947; and Harrison, 1949).

Retrosternal Route.—By this method the jejunal loop is led through a tunnel retrosternally across the anterior mediastinum—Robertson and Sargeant, of Vancouver (1950), and independently by Eremeev, of the U.S.S.R. (1951). The advantages of the retrosternal œsophagus are both æsthetic and functional. Young people especially are less self-conscious with a retrosternal gullet, and mechanically the jejunal loop placed retrosternally functions better than the one placed subcutaneously. The sucking action of the chest also helps when the artificial œsophagus is in the retrosternal position. No accessory or unpleasant reactions have been observed in connexion with the action of the heart or movement of the lungs. (*Figs.* 588–591.)

The following questions must now be considered:

1. Are the advantages of the retrosternal route justified by the risks of the operation?

2. What dangers and complications arise in constructing a retrosternal œsophagus?

In the early days of our experience we were apprehensive of the consequences of producing a unilateral or bilateral pneumothorax during the

fashioning of the retrosternal tunnel. The latter seemed likely to be dangerous. Another serious complication that may arise is a complete or partial necrosis of the jejunal loop.

Furthermore, such necrosis, occurring as it does in the concealed space behind the sternum, makes early diagnosis and effective treatment more difficult than when the jejunal loop lies subcutaneously. Our experience is set out in *Table I.*

In *Chirurgia* (Moscow) 1954, No. 1, we reported the first 15 operations of restrosternal œsophagus from

FIG. 588.—A boy aged 4 years was admitted in February, 1955, with a gastrostomy. Treatment: Retrosternal œsophagus from a jejunal loop. May 9: Transplantation of jejunal loop. May 14: Anastomosis—end-to-side—between the jejunal loop and the œsophagus. Aug. 14: Anastomosis of the jejunal loop with the stomach.

FIG. 590.—A girl aged 5 years was admitted to the Clinic in 1954. Treatment: Retrosternal œsophagus from a jejunal loop. Nov. 11: Transplantation of jejunal loop. Nov. 15: Anastomosis—end-to-side—between the jejunal loop and the œsophagus. Jan. 15, 1955: Anastomosis of the jejunal loop with the stomach.

FIG. 589.—Radiograph of the same patient showing the retrosternal œsophagus in position. The jejunal loop was led through the anterior mediastinum.

FIG. 591.—Radiograph of the same patient showing functioning retrosternal œsophagus. The jejunal loop was led through the anterior mediastinum.

a jejunal loop, with 2 deaths. A year later, in a report made at the XVth Congress of Indian Surgeons (Hyderabad) we gave an account of 25 similar operations with 3 deaths. In August, 1955, at the 1st World Congress of Plastic Surgery in Stockholm we were able to report 37 operations with the same mortality-rate (3 deaths).

In this article we offer an analysis of 69 retrosternal operations. In 48 cases patients had their artificial œsophagus made out of a jejunal loop and in 21 the left or the right half of the colon was used for this purpose.

As already stated, a retrosternal artificial œsophagus was created in 69 cases: of these 6 died.

Table I.—Comparative Figures of the Mortality-rate in creating Antethoracic and Retrosternal Artificial Œsophagus in Patients with Benign Stricture

(*Sklifosovsky Institute*)

Method of Operation	Years	Number of Cases	Died
Antethoracic (out of jejunal loop) Yudin, S. S.	1942–1948	256	24 (9·0 per cent)
Antethoracic (out of jejunal loop) Petrov, B. A., Arapov, D. A., Chundadze, G. K., and others	1949–1953	252	11 (4·3 „ „)
Retrosternal (out of jejunal loop) Petrov, B. A.	1952–1956	48	4 (8·4 „ „)
Retrosternal (out of colon) Petrov, B. A.	1956–1957	21	2 (10·0 „ „)

The table shows that the mortality rate for bringing the jejunal loop up by the retrosternal route is less than that for the subcutaneous route in the 1942–8 series and more than that for the subcutaneous route in the 1949–53 series. Only one patient—a girl aged 7 years—died as a result of a bilateral pneumothorax. Her death was due to failure to recognize the cause of her condition post-operatively.

COMPLICATIONS

Pneumothorax.—The fears that pneumothorax occurring during the preparation of the retrosternal tunnel would prohibit further surgery proved to be groundless.

In the series under review the parietal pleura was undamaged in 13 patients: one-sided pneumothorax occurred in 15 patients (12 right side, 3 left side) and there were 22 cases of bilateral pneumothorax. Since we began to use general anæsthesia with curarization for the retrosternal operation we experienced rupture of the parietal pleura but rarely. The technique used with the last 18 patients operated upon was as follows:—

General anæsthesia was induced using a Mackintosh apparatus, and an endotracheal tube was passed. An intravenous injection of 8–10 ml. 0·2 per cent ditilin (curacid) was then given before starting to make the retrosternal tunnel. Spontaneous respiration ceases for 7–12 minutes. This interval allows the surgeon time to make a tunnel from below in the plane between the immobile pleural cavity and to open the retrosternal space from above without damaging the pleura.

When a patient's breathing is 'controlled' it is mainly the diaphragm that contracts, and to a lesser degree the chest is expanded.

Thanks to this the thin, tissue-paper-like pleural leaves do not sway and do not protrude into the cavity of the opened retrosternal tunnel and thus are not so likely to rupture. If the presence of a pneumothorax is doubtful at the end of the operation, radiography should be carried out and, if necessary, aspiration.

The jejunal loop should be led through the anterior mediastinum in the midline of the retrosternal space dividing the friable cellular tissue between the pleural cavities. In this space colon can be accommodated as readily as jejunum.

Necrosis of the Jejunal or Colonic Loop in the Retrosternal Space.—This is a more dangerous complication than pneumothorax. Three patients died as a result of necrosis of part of the jejunal loop. This accident occurred as a result of violation of the main principle—namely, that transfer of a jejunal loop into the retrosternal space should only be undertaken if the blood-supply of the mobilized loop appears on inspection to be assured and safe. In the 3 fatal cases the nutrition of the jejunal loop was doubtful at the time of transfer. Besides, at that time (if ischæmia was suspected) we did not appreciate the importance of immediately withdrawing the jejunal loop from its retrosternal tunnel, excising the non-viable portion, and transferring the rest of the loop under the skin. This simple operation is not dangerous, but delay in doubtful cases leads to death. The jejunal loop is readily taken from its retrosternal tunnel. The following account illustrates such a case:—

A male patient, aged 10 years, was admitted to the clinic on Sept. 24, 1953, for the establishment of an artificial œsophagus. The œsophagus was strictured from the level of D.1 downwards throughout its length following a burn as a result of swallowing an alkaline solution at the age of 7 years. For the last two years the boy had been feeding through a gastrostomy.

Operation (Oct. 7) (B. A. Petrov).—Under endotracheal anæsthesia. Midline laparotomy incision. Mobilization and preparation of the jejunal loop by Roux-Herzen's method with ligation of four vessels. End-to-side entero-anastomosis. Additional mobilization of the root of the mesentery. Preparation of the retrosternal tunnel from below. On completion of this, an incision was made above the jugular notch and the tunnel was opened from above and widened with the aid of a finger. As the jejunal loop was of good colour, it was threaded into and through the tunnel. Above it was sutured neither to muscles nor to fascia. An associated bilateral pneumothorax was aspirated with a suction apparatus.

For the first few days after the operation the boy's condition was good. On the third post-operative day (Oct. 10) it was decided to connect the jejunal loop with the œsophagus. However, when the skin sutures in the neck were removed the jejunal loop could not be found. It had retracted into the retrosternal cavity. Therefore a week after the first surgical interference (Oct. 14) a second operation was performed.

Under endotracheal anæsthesia the abdominal cavity was re-opened. The jejunal loop was situated in the lower part of the retrosternal tunnel. The loop was withdrawn, the tunnel re-opened, and the jejunal loop re-introduced

into the retrosternal cavity. On this occasion it was sutured to the muscles with silk. A pneumothorax that occurred was again aspirated and following a radiological check aspiration was repeated a few days later.

A week later (Oct. 21) the jejunal loop was anastomosed to the œsophagus (side to side). When he had recovered from the operation the boy left the hospital for a period of convalescence. In December he was re-admitted. The gastric stoma was excised and the jejunal loop sutured to the stomach by side-to-side anastomosis. A quick recovery followed.

We received word four years later that the boy was in good health. He is now studying and playing games and has grown in stature and strength.

Since this experience we no longer wait in doubtful cases. If a patient is not well after the operation, if his temperature remains high and the pulse-rate is accelerated, a radiograph is immediately taken. Considerable widening of the shadow of the jejunal loop behind the chest and the presence of horizontal levels testify to the paralysis of the loop. In the presence of these findings the wound in the neck was opened and if the upper end of the loop was found to be non-viable, the incision in the abdomen was re-opened and the jejunal loop was withdrawn from the tunnel without difficulty.

The loop was then laid under the skin so that it was in position and ready to be used for the creation of an antethoracic subcutaneous œsophagus. This method was used in 7 patients.

Necrosis of the loop resulted in 3 deaths, which took place in the tenth, fourteenth, and seventeenth cases operated upon.

From our experience we would re-affirm that:—

1. A good blood-supply is essential for the safe transference of a jejunal loop to the retrosternal space.

2. Care should be taken to avoid large tears in the pleura.

With the exception of the 4 patients referred to above who died, and those (7) who had their loop transferred from the retrosternal tunnel under the skin, the remaining 37 patients had their loop brought up to the neck through the anterior mediastinum. Of these, 7 were children aged from 5 to 12 years.

We usually make the connexion of the loop with the œsophagus in the neck at a second stage, 3–5 days after the main operation. After an interval of 3–6 months the function of the new œsophagus is assessed and if this is satisfactory the gastric stoma opening in the skin is excised and at the same time the opening left in the stomach is connected with the intersected jejunal loop and an end-to-side anastomosis is established.

On the whole, our experience has shown that the retrosternal œsophagus has such considerable advantages that it is to be preferred to other ways of creating an artificial œsophagus. For the last two years in our practice this method has taken priority of place, leaving subcutaneous and intrapleural methods far behind. However, although this method of creating an artificial œsophagus from a jejunal loop is an advance (together with the added safety to its blood-supply mobilization of the root of the mesentery affords), there still exists a certain risk to the viability of the transposed loop. The blood-supply of the jejunal loop is so very easily cut off. The whole history of the development of this operation testifies to this constant and particular risk.

The Use of Colon.—It is for this reason that the operation of transference of a segment of the colon, as suggested by Kelling (1911) and Vulliet (1911), has again found an application. Thanks to antibiotics 'sterilization' of the loop contents by the use of colimizin is now possible and anastomosis of the colon has lost much of its danger.

Thus we may say that the overall risks of the operation have been reduced. Fortunately the colon has a good blood-supply, which is maintained even if the right or left colic artery is ligated. Our confidence in the colon has increased as a result of our experience of transposing the left and the right sides of the colon into the retrosternal cavity.

We hope that this brief communication will interest British surgeons sufficiently to encourage them to give a trial to the establishment of a retrograde artificial œsophagus using jejunum or colon for the relief of cases of benign œsophageal stricture.

SUMMARY

A method of treatment of benign stricture of the œsophagus by the creation of a retrosternal artificial œsophagus is described. The advantages of the retrosternal position are contrasted with the disadvantages of the subcutaneous position.

The complications of the operation for establishing an artificial œsophagus in the retrosternal position are discussed and measures for their prevention outlined.

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VARICOSITY OF THE EXTERNAL AND PSEUDO-VARICOSITY OF THE SHORT (EXTERNAL) SAPHENOUS VEIN

By HAROLD DODD, London

THE diagnosis and treatment of varicosity of the short (external) saphenous vein are reviewed because experience is showing that this vein is varicose more frequently than was thought, and that its variable anatomy affects the results. From 1929 to 1954 my patients with varicose veins suggested that the external saphenous vein was incompetent about one-tenth as often as the long saphenous vein. Attention to its possible varicosity was directed by persistent and recurrent varices after the ligation of the long saphenous vein, which were occasionally found to be due to an unnoticed varicose short saphenous vein (*Fig.* 592). Since 1953, search for it is proving it to be varicose about one-seventh as often as the long saphenous vein. A further stimulus to it was received in 1954 when during the subfascial operation of division of the ankle communicating veins (Cockett, 1953) it was seen to be varicose although it had not been so noticed clinically. The result is that in 1953 42 short saphenous veins were operated on, in 1957 67, and in 1958, by March 30, 30 had been explored.

FIG. 592.—An unnoticed varicose short saphenous vein. This patient has already had the long saphenous vein ligated and stripped.

Further, as more short saphenous veins are treated and followed up, two other features are emerging: first, because of the variability of its termination there may be difficulty in exposing its ending, except with a large incision; secondly, in some patients, after it has been divided flush at its union with the popliteal vein and its trunk stripped out to the ankle, considerable varices remain when they return afterwards (*Figs.* 593, 594). These persistent varices sometimes arise from other varicose tributaries of the popliteal vein. Such vessels give signs and symptoms similar to those of the varicose short saphenous veins. They are demanding that the presentation be more carefully assessed, and have required study of the tributaries of the popliteal vein, which, because of their similarity to the incompetent short saphenous vein, have been called 'pseudo-varicosity' of the short saphenous vein. Therefore, based on over 92 operations on the short saphenous and varicose popliteal tributaries, the condition is reviewed here.

SURGICAL ANATOMY OF THE SHORT SAPHENOUS VEIN

The short saphenous vein and its tributaries drain the skin and fat of the heel and calf. Its trunk passes behind the external malleolus to the outer border of tendo Achillis, and runs on the deep fascia, up the centre of the calf, into the popliteal space, where it *usually* joins the popliteal vein. In the upper half of the calf its trunk is covered by a film of deep fascia; this and its somewhat deep position render it inconspicuous, and unless it is grossly varicose, or the limb is thin, it may not be visible and occasionally is impalpable, unless the knee is slightly flexed.

Termination.—The termination of the short saphenous vein is variable. It was studied and described by Kosinski in 1926. The more radical operation, which increasing experience has required, is confirming his findings. It may be helpful to recall them:—

1. '*Normal*' *Ending.*—In Kosinski's series the short (external) saphenous vein joined with the popliteal vein above the knee-joint by a varying sized vessel in 57·3 per cent. (This occurred in 82·7 per cent of my patients—72 of 87 cases—5 being exactly at the knee-joint.) A constant extension passed upward either to the long (internal) saphenous vein, the deep veins of the hamstrings, or to a peripheral tributary of the internal iliac vein.

2. '*High*' *Ending.*—In 26·6 per cent the short saphenous vein passed through the popliteal space without communicating with the popliteal vein. It emptied into the deep veins of the thigh, or into the long (internal) saphenous vein. (I found this in 11·5 per cent of my series—10 cases.) (*Fig.* 595.)

3. '*Low*' *Ending.*—In 9·9 per cent the short (external) saphenous vein finished below the knee by uniting with the calf muscle veins, or the long (internal) saphenous vein. (This was seen in 5·7 per cent of my operations—5 cases.)

In 3 other persons the ending was not determined because they had been operated on before and were apparently in the popliteal space; in 2 the notes were omitted, so 87 dissections are reported here.

Until 1955 Kosinski's variations were seldom found because they were not looked for and the

exposure used was hardly adequate, but now that a full dissection of the popliteal space is being made they are being recognized.

Locating the Termination.—The termination of the short saphenous vein, ranging from the mid-calf to the thigh, obviously complicates the radical operation, but assistance in locating its end is available by:—

1. *Palpation*: The enlarged varicose short saphenous vein can usually be palpated in the

FIG. 593.—A short saphenous vein which has been operated on three times; persistent varices due to pseudo-short saphenous veins. *See Fig.* 604 for post-operative result.

FIG. 594.—Persistent varices after sapheno-popliteal ligation, short saphenous stripping, and ligation of ankle perforating veins. These veins are controlled by pressure on the popliteal vein at the knee-joint; they were due to a varicose medial gastrocnemial vein.

FIG. 595.—Venogram of a short saphenous vein passing without communication through the popliteal space to the upper thigh.

popliteal space and calf, especially if the knee is flexed slightly, as when standing-at-ease. Its highest palpable point indicates where it turns in to join the popliteal vein, when it may unite at this level or a little lower like a shepherd's crook, or pass obliquely upwards lying on or beside the parent vein for 1–2 in., joining at the adductor foramen.

2. *The stripper*: In 50 per cent of patients when the stripper is passed from the ankle along the saphenous trunk it impacts at the sapheno-popliteal junction and is discernible there. In some the stripper runs uninterruptedly into the popliteal and femoral veins, or into a vein to the hamstrings. Occasionally it runs into the long saphenous vein

FIG. 596.—Recurrent varicose right short saphenous and left long saphenous veins. A, The short saphenous exclusion test is illustrated in the right leg. B, Overlooked (right) short saphenous varicosity in recurrent varicose veins. C, Varicose long saphenous left. D, The same legs after operation.

FIG. 597.—Bilateral short saphenous varicosity and right long saphenous incompetence with eczema.

above or below the knee-joint or impacts in a calf vein.

3. *A venogram*: When necessary a venogram will show the exact ending of the varicose external saphenous vein (*Fig.* 595).

Connexions.—The long and short saphenous veins are connected by veins in the upper and lower thirds of the inner leg and in the thigh. Through these the hypertension in one incompetent system can pass into the tributaries of the other and render them varicose, although the terminal valve of that saphenous vein is sound. The varicose long saphenous vein distends the short saphenous tributaries more often. This possibility may render a 'spot' diagnosis based on the distribution of the varices wrong or incomplete.

PHYSIO-PATHOLOGY OF THE SHORT SAPHENOUS VEIN

The territory drained by the short saphenous vein is approximately the skin and fat of the lower calf and ankle; this is a much smaller area than that of the long saphenous system (i.e., the anterolateral and medial aspects of the thigh and leg), and, therefore, when the short saphenous vein is varicose, the hypertension in it is exercised on this relatively limited area, especially at the ankle, and proportionately more ill-effects such as pain, swelling, eczema, and ulceration of the ankle follow varicosity of the short saphenous vein than the long saphenous; thus it is important to recognize it.

THE DIAGNOSIS OF VARICOSITY OF THE SHORT SAPHENOUS VEIN

Varicosity of the short saphenous vein is diagnosed by inspection, palpation, digital percussion, and tourniquet tests. A varicose short saphenous vein may be associated with incompetence of other veins such as the long saphenous vein, defective popliteal tributaries close by, and also incompetent ankle perforating veins. Rarer associations are a defective communicating vein passing into Hunter's canal or through tensor fasciæ femoris to muscular veins of vastus externus. Further, a person's legs are seldom alike; both can have varicose veins, but filling from different sources (*Fig.* 596).

Although familiar with varicose veins, I think I overlook the short saphenous vein more than any other, as instanced by *Fig.* 592.

Inspection.—The lower limbs are inspected from the umbilicus to the toes, including the pubis, the popliteal space, calf, and ankle. Arresting varices on the front of the limb have sometimes caused me to omit to look behind.

In a thin person the varicose short saphenous trunk may be visible on the calf and popliteal space, possibly with a terminal varix (*Fig.* 597). In a thick-skinned and fat limb it is usually palpable but not visible. Clusters of veins may protrude anywhere on the calf. The groove behind the external malleolus is often obliterated by œdema and/or varicosities, and the skin may be pigmented, scaly, ulcerated, or scarred. These changes depend on the duration and degree of the incompetence. The inner ankle may be similarly affected, for the hypertension in the short saphenous vein can pass by a connecting vein over tendo Achillis to this area and wield its destructive effect there also (*Fig.* 598).

Palpation.—The short saphenous trunk is felt for throughout its course; as a rule, when varicose it is discernible and enlarged from the ankle to the knee; this is one differentiation from a pseudo-short saphenous varicosity. Sometimes it is only palpable in its lower half, as in the calf it is covered by a thin

FIG. 598.—Varicosity of the short saphenous vein causing an ulcer at the internal malleolus and demonstrating the short saphenous exclusion test.

layer of fascia which tends to conceal it. It is easier to feel the short saphenous vein from in front than from behind.

The 'High-ending' Short Saphenous Vein.—I have not diagnosed one of these clinically, partly because I am not fully conditioned to the possibility and also because the vein seems to disappear at the popliteal space as does the normal short saphenous vein. I hope to find one which is palpable to the hamstring muscles. Logically, a high short saphenous vein would be kept empty by a tourniquet around the lower third of the thigh, whereas one ending in the popliteal space would fill with such a band. Both vessels should be palpable and perhaps visible from the knee downwards. The other varicose veins controlled by a band at the lower third of the thigh are the varicose long saphenous and the incompetent veins passing into the superficial femoral vein at Hunter's canal, but the high-ending short saphenous would be controlled by thumb pressure at the upper end of the popliteal space whilst the other two would not; this principle is used in the exclusion test for the short saphenous vein (*see* p. 525).

The 'Low-ending' Varicose Short Saphenous Vein.—The trunk of the enlarged short saphenous vein is palpable from the ankle to the point on the calf where it passes deeply or veers to the long saphenous vein. It cannot be felt at the popliteal space; any enlarged veins here are probably from gastrocnemius.

Tourniquet Test.—If the lower limb is raised, the varices emptied, and a tourniquet applied at the

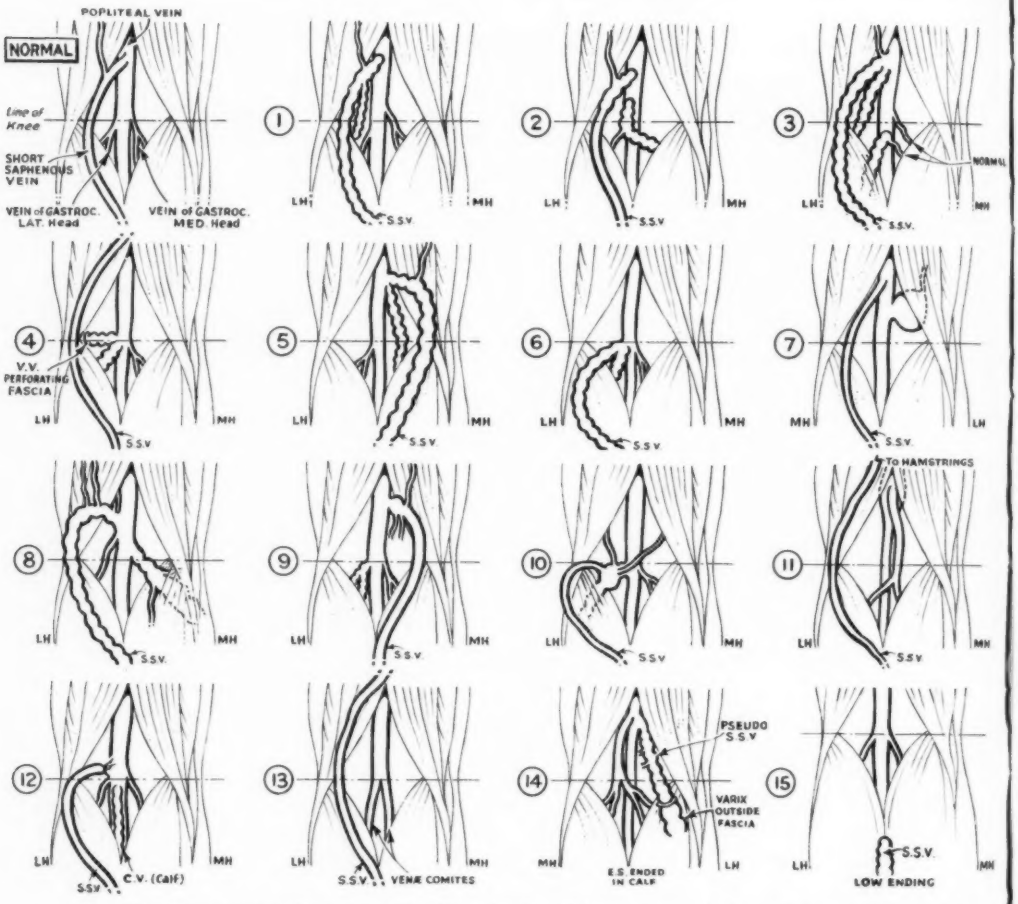

FIG. 599.—Sixteen drawings of operation findings illustrating the varied venous anatomy in the popliteal space, especially of the varicose short and pseudo-short saphenous veins. (They are translated where necessary to be left-sided for purposes of comparison.)

The percussion test is positive from the calf to the ankle. A tourniquet at this level in the calf keeps the varicose trunk below empty, but not if it is applied at the knee-joint, as occurs in the normal and thigh-ending varicose saphenous veins.

Cough Impulse.—On coughing, an impulse is rarely felt in an incompetent short saphenous vein, but if it is present, I consider that it indicates incompetence of the valves of the iliac, femoral, and popliteal veins.

Percussion Test.—On lightly tapping the varicose external saphenous trunk at the knee-joint with the finger-tips as the patient stands, a vibration is discernible to the ankle, and in its larger tributaries. This is a quick and dependable sign, although I do not think that it is as sensitive as the tourniquet test.

lower third of the thigh, it will be above the end of 75–85 per cent of short saphenous veins (i.e., normal and low endings). When the patient stands, if this vein is incompetent, the varicose veins below the band will distend. They can also fill from incompetent popliteal tributaries, and defective ankle communicating veins. Should the veins remain empty, then these vessels are sound. If, when the band is released, the veins distend promptly, then varicosity of the long saphenous vein, an incompetent communicating vein passing into Hunter's canal, tensor fasciæ femoris, or a high-ending short saphenous vein would be indicated.

The test is repeated, with the thigh tourniquet, but to exclude the short saphenous vein and popliteal tributaries a band is placed at the knee-joint. After the patient has stood for 20 sec., any faulty communicating veins below the knee-joint band will have filled the varices to some degree of tension, probably from the ankle perforating veins, other communicating veins, or occasionally from a low-ending short saphenous vein. The lower band is removed, and if the previously partly filled or empty veins fill promptly and tensely, the short saphenous vein or the popliteal tributaries are inefficient. The latter will be discussed shortly.

The Short Saphenous 'Exclusion' Test.—This is a valuable differentiating sign when the internal and external saphenous and Hunter's canal communicating veins (CV-H) are all suspected of incompetence. The state of the short saphenous vein is known from the tourniquet test already described; it is the competence of the long saphenous and Hunter's canal communicating vein which need to be proved. The principle used is to exclude the short saphenous vein by digital pressure at the popliteal space (*Fig.* 598). The bands are re-applied at the lower third of the thigh and at the knee-joint. The patient stands and the thumb is pressed on the midline behind the knee at the joint-level beneath the tourniquet here. This compresses the short saphenous vein and most of the popliteal tributaries. Both bands are removed and the varicosities are watched. Those that fill must do so from incompetent veins other than the short saphenous vein and tributaries of the popliteal vein, for these are controlled by the thumb pressure. Thus, if the long saphenous vein and/or Hunter's canal communicating veins are varicose, some of the veins will fill, but not if they are sound. If, after 20 sec., the compression is released, and the varices fill or become more tense, then the external saphenous vein and/or defective popliteal tributaries are incompetent, but this is known from the previous tests.

Both Legs.—Occasionally both the long and short saphenous veins are incompetent in a limb. Of equal incidence is that of a varicose long saphenous vein in one leg, and of the short saphenous vein in the other, so each leg is tested (*Figs.* 596, 597).

PSEUDO-VARICOSITY OF THE SHORT SAPHENOUS VEIN

(*See Fig.* 599, 1–15)

This name is given to varicose tributaries of the popliteal vein because their signs are similar to those of the faulty short saphenous vein. The following varicose tributaries of the popliteal vein have been found:—

The Gastrocnemial Veins.—They are the chief incompetent tributaries of the popliteal vein.

The Anatomy.—Usually two large veins arise from each inner and outer heads of gastrocnemius. They join the popliteal vein separately at the level of the knee-joint, but they vary as follows:—

1. The veins from one or other head may join the last inch of the short saphenous vein. This was seen 17 times in each head (*Fig.* 599, 1).

2. Fairly often one or the other gastrocnemial vein joins the popliteal vein at the same point as the short saphenous vein, helping to form the venous web here (*Fig.* 599, 3, 5, 6).

3. The veins from each head may form a common trunk and either pass into the popliteal vein immediately, or join it at the adductor opening; this looks like a double popliteal vein. These variations have each been seen twice (*Fig.* 599, 3, 11).

The Varicosity of the Gastrocnemial Veins.—The vein from the medial head of gastrocnemius is varicose more often, having been seen at 51 operations, in contrast to the lateral head on 22 occasions. The lateral and medial were both varicose on 7 occasions.

FIG. 600.—A varicose pseudo-short saphenous vein.

Other Varicose Veins.—Indirect varicose tributaries of the popliteal vein are veins which penetrate the popliteal fascia and join either the short saphenous vein towards its end, or one of the gastrocnemial veins. Such a vessel was found at 21 operations. These varicose veins drain clusters of varices of the lower thigh, popliteal space, or calf. They often pass in through one of the two longitudinal grooves behind the knee (*Figs.* 599, 14, 600).

The Tibial Communicating Vein (CV-T).—A connexion called the 'tibial communicating vein' links the anterior vein of the leg (a tributary of the long saphenous vein) with the veins of the inner head of gastrocnemius and thence to the popliteal vein. This has been found to be incompetent 5 times, although it has not been looked for consistently. This perforating vein penetrates the deep fascia at the posterior border of the tibia at the upper third. When it is incompetent pressure here keeps the anterior vein of the leg and its tributaries on the front of the leg and the dorsum of the foot empty. As

these vessels can be rendered varicose by an incompetent long saphenous vein a differential diagnosis is necessary (*Fig.* 601).

veins 12 times and in 3, only the pseudo-short saphenous veins were incompetent.

The findings are epitomized in *Tables I, II*.

FIG. 601.—A persistent varicose vein due to a tibial communicating vein which passes into gastrocnemius and thence to the popliteal vein. This patient has already had the long saphenous vein tied and stripped to the ankle.

Veins of Biceps and Semimembranosus.—A muscular vein from biceps or semimembranosus has been incompetent on 4 occasions; these are rare (*Fig.* 599, 7).

A Calf Communicating Vein.—A varicose calf communicating vein has been seen five times. It arose from the short saphenous vein at the mid-calf and ran obliquely through gastrocnemius to join the popliteal vein at the knee-joint level. Its identity was proved by passing a stripper down it from the popliteal space. Dow described this vein from his venographic studies in 1951 (*Fig.* 599, **12**).

The Short Saphenous Vein.—Of 82 patients operated on with pseudo-short saphenous veins, the short saphenous vein was varicose 53 times and was normal in 29; in 6 it had already been operated on. In 23 recent consecutive operations on the popliteal space the short saphenous vein alone was varicose 8 times; it was associated with pseudo-short saphenous

Table I.—FINDINGS IN 82 CASES OF PSEUDO-SHORT SAPHENOUS VEINS

	Cases
Popliteal veins explored	92
1. Short saphenous veins varicose	63
2. Short saphenous vein *only* varicose	10
3. Short saphenous vein varicose *plus* 'other' tributaries varicose	53
4. 'Other' tributaries *only* varicose	29
5. Total 'other' tributaries varicose	82

Changes in the Popliteal Vein.—Abnormalities have been seen in the popliteal vein:—

1. The posterior tibial venæ comites persisted as equally sized vessels 3 times, once to 1 in. above the knee-joint and twice to the adductor opening (*Fig.* 599, **13**).

2. The popliteal vein was occasionally bulbous or pouched, and as large as the iliac vein and obviously incompetent. It was seen to dilate and contract with the heart-beat and respiration. I think that this denotes the absence of valves between it and the right auricle.

3. A saccular varix on the popliteal vein occurred on 1 occasion; it was the size of a walnut and had a small connexion with the muscular vein from biceps muscle. It was twisted like a hernial sac and transfixed with fine thread, flush on the popliteal vein (*Fig.* 599, 7).

4. The vein was partially thrombosed on 1 occasion.

Table II.—'OTHER' TRIBUTARIES VARICOSE

	Cases
1. Vein of medial head of gastrocnemius	51
2. Vein of lateral head of gastrocnemius	22
3. Medial and lateral head veins varicose	7
4. Varicose vein from hamstrings	4
5. Varicose calf-communicating vein	5
6. Varicose vein to short saphenous or gastrocnemial veins	23

The Physical Signs of Pseudo-short Saphenous Incompetence.—Varicose tributaries of the popliteal vein are generally associated with a defective short saphenous vein (53 in 82 cases), therefore the signs of a varicose short saphenous vein will be often present. In 29 operations only pseudo-short saphenous veins were found, and some of these had not been noted pre-operatively. They cause varicosities about the lower thigh, popliteal space, calf, and the front of the leg. Hints of their signs have been made already.

FIG. 602.—The exclusion test for a pseudo-short saphenous vein. Notice that there is no sign of an enlarged short saphenous trunk, or filling of the ankle grooves.

Ordinarily the proof of an incompetent external saphenous vein is established when, after emptying it and pressing its end at the popliteal space, its trunk and tributaries remain collapsed as the patient stands. The same pressure, however, occludes the varicose popliteal tributaries too, so their diagnosis is largely that of proving that the signs of short saphenous incompetence are modified (*Fig.* 604).

The diagnosis is deductive rather than direct. Some suggestions are:—

a. A cluster of varices with skin changes, scarring, and fullness behind the external malleolus is suggestive of short saphenous incompetence, whilst normal ankle grooves and good skin suggest that the short saphenous vein is competent and that the varices higher-up may be from pseudo-short saphenous veins (*Fig.* 602).

b. A globular varix is sometimes palpable behind the slightly flexed knee in the middle line. If it is on the short saphenous vein it can be traced lower and possibly a little higher. If it cannot be followed lower it is likely to be a pseudo-short saphenous varicosity, and especially if it extends somewhat to one or both sides of the midline. These suggest varicosity of one or both gastrocnemial veins.

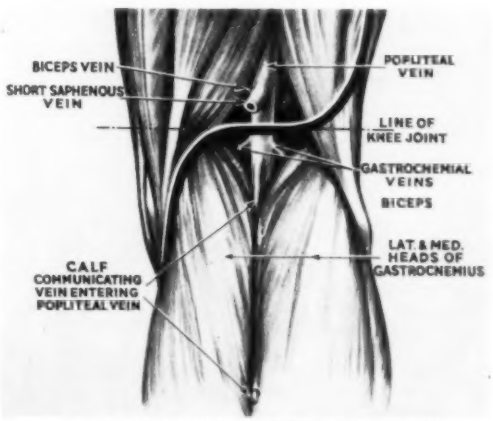

FIG. 603.—The S-incision for exposure of the popliteal vein; also the approximate normal anatomy.

c. The occasional finding of a varicose anterior vein of the leg, which is controlled by pressure at the posterior border of the upper tibia, has been mentioned (*Fig.* 601).

d. A cluster of varices about the popliteal space or calf is usually filled by a varicose vein joining a gastrocnemial vein or short saphenous, although the latter is not necessarily varicose (*Fig.* 600).

e. A group of varices at the union of gastrocnemius and tendo Achillis is suggestive of a varicose gastrocnemial or calf communicating vein.

f. Persistent varicose veins about the popliteal space and calf after the short saphenous vein has been terminally ligated and stripped (*Figs.* 593, 594).

If the principle is accepted of the need to explore the tributaries of the popliteal vein as well as the between the short saphenous and gastrocnemial veins.

TREATMENT OF THE VARICOSE SHORT SAPHENOUS VEIN AND INCOMPETENT TRIBUTARIES OF THE POPLITEAL VEIN

The frequency of these varicose findings has indicated the advisability of exploring all the popliteal vein and ligating incompetent tributaries flush on it.

The Incision.—An adequate incision which will heal soundly is needed. A midline longitudinal

FIG. 604.—The curved incision for exposure of the popliteal and short saphenous veins. This is proving a satisfactory alternative approach. Note that the upper half is in the inner groove behind the knee.

FIG. 605.—The post-operative result of the operation on the veins illustrated in *Fig.* 593 after legation of the varicose tributaries of the popliteal vein. Note the curved incision.

short saphenous vein for inefficient veins filling from this area, then the diagnosis need not be exhaustive.

Question.—When gastrocnemial tributaries are varicose, where does their hypertension pass into the superficial veins? From this series I would say that they 'surface' at the popliteal space, the calf, and at the musculo-tendo Achillis junction. Some of these veins constitute the indirect communicating veins spoken of by Le Dentu (1867). Such veins pass inwards into the muscular veins which join others to form the main gastrocnemial veins. In a few cases of exceptionally large gastrocnemial veins I have dissected them distally through the muscle and found these subcutaneous connexions. I had in mind the possibility of an intramuscular arteriovenous fistula. Turner Warwick (1931) mentions large connexions

incision gives good access, but a keloid, eczematous, weak, or ulcerated scar may follow. Two incisions have been found to be satisfactory. First, the S-shaped incision (*Fig.* 603) is efficient and conforms with the canons of skin incisions. It starts in the medial longitudinal groove and curves horizontally outwards in the knee skin crease for $\frac{1}{2}$–1 in. and down the calf for 3–4 in. Secondly, a gently curving longitudinal incision starting above in the medial groove behind the knee to the transverse skin crease thence gently curving towards the centre of the calf for 4 in., being 7 in. long in all (*Fig.* 604). It has been used since June, 1957, without ill-effect (*Figs.* 604, 605). Both incisions are deepened through the deep fascia. If the S-incision is selected the flaps are reflected to display the popliteal space. With the curved incision, the lateral flap is raised off the

muscles, giving a similar exposure. A varicose superficial tributary of the short saphenous or a gastrocnemial vein which penetrates the popliteal fascia may be exposed during this, and is divided; it was seen 21 times in 82 operations.

The Short Saphenous Vein.—The short saphenous vein is readily seen in the slight central groove between the heads of gastrocnemius. It is followed to its union with the popliteal vein, which is usually in the upper half of the popliteal space, frequently close to the adductor opening. A constant vein from the thigh joins it about 1 in. from its end. The sural nerve, of variable size, lies beside the short saphenous vein throughout its course in the popliteal space, and is preserved.

The short saphenous vein is traced deeply through a mass of fat to the popliteal vein, which is overlaid by the medial popliteal nerve which looks like a tendon. At the sapheno-popliteal junction there is often a web of small and medium-sized fragile veins which constitute a venous plexus from which copious bleeding readily occurs, even when care is taken. Occasionally a large medial or lateral gastrocnemial vein joins here. The short saphenous vein is doubly tied at the sapheno-popliteal junction and adjoining varicose tributaries are divided.

The 'High-ending' Short Saphenous Vein.—When the short saphenous vein passes through the popliteal space with but a slight or no connexion with the popliteal vein it is followed as far as possible before its division. In 2 instances it continued superficial to the deep fascia and did not enter the popliteal space. Once it joined the long saphenous vein in the thigh. The stripper inside it is helpful in tracing them. A sapheno-femoral ligation may be needed.

The 'Low-ending' Short Saphenous Vein.—In the low-ending short saphenous veins the stripper impacts early in the calf, and cutting down on to its tip will show it dipping into the calf muscles or joining the long saphenous vein below the knee.

The Popliteal Vein.—The popliteal vein appears from under gastrocnemius and is covered by the medial popliteal nerve and lies on the popliteal artery. It is most superficial at the knee-joint level, where it is surrounded by a leash of veins, branches of the popliteal artery, and divisions of the medial popliteal nerve. No lymphatic gland has been seen in the popliteal space during 92 operations.

Tributaries of the Popliteal Vein, i.e., Pseudo-short Saphenous Veins.—The varicose popliteal tributaries appear, especially the veins from gastrocnemius about the level of the knee-joint.

To see them the heads of gastrocnemius must be separated to the upper third of the calf or they are readily missed. They are variable and their considerable size may cause them to be mistaken for the popliteal vein; indeed, twice in this series, in a complicated venous presentation, the popliteal vein was ligated in error. Fortunately no ill-effects ensued.

In 3 patients the vein of the medial head was enormous, forming a visible and palpable varix in the popliteal space. The vessels were traced back through gastrocnemius to the mid-calf, where a large perforating vein joined it. They were divided with a good result.

Tributaries from semimembranosus and from biceps are exceptional. These muscles obviously drain to higher levels.

The oblique calf communicating vein is revealed by opening fully the space between the gastrocnemial heads; it is readily seen when varicose.

Manifest incompetence of the popliteal vein has been found frequently, but nothing has been done for it, although Bauer's work would suggest benefit from its ligation if associated with ulceration and a swollen leg. In my patients ligation of the short and pseudo-short saphenous veins and faulty calf and ankle communicating veins has given good results.

A Test for an Incompetent Vein at Operation.—Occasionally at operation a largish vein is found the incompetence of which is doubtful. A simple test will decide this. A strand of thick catgut is passed around the vessel twice and held taut by a hæmostat; this gently occludes it. A normal vein distends below the constriction, especially if the foot is flexed once or twice—this increases the venous return. If the vein is defective it may shrink as it is no longer filled from a backflow. Next, the vein is rapidly injected with normal saline below the catgut, i.e. retrogradely. Competent venous valves will not permit a backward flow so the vessel distends and the saline may squirt out alongside the needle. By contrast a defective vein will accept any volume of saline (e.g., 40–50 ml.), inserted as rapidly as possible without distension. Such a vein is divided.

Stripping of the Short Saphenous Vein.—When the incompetent tributaries of the popliteal vein are tied it remains to strip out the varicose short saphenous vein. At the ankle it lies on the deep fascia immediately outside the tendo Achillis, 2 in. above the tip of the external malleolus. The large sural nerve is adherent to it, and this identifies it. They are separated as its injury is followed by anæsthesia of the outer border and dorsum of the foot, and patients complain of it continuously. The vein is half cut across, the stripper is threaded into it until its tip emerges in the popliteal space. The vein at the ankle is divided; the space proximal to it is opened freely for 2 in. to admit the stripping shoulder into the correct tissue plane. Before stripping the vein both wounds are closed except for one stitch at the knee, where the fusiform mass of telescoped vein will emerge on the stripper. The limb is pressure-bandaged as the vein is stripped so that bleeding from torn tributaries is minimized.

When the primary diagnosis is varicosity of the short saphenous vein this vessel is first exposed at the ankle, and the stripper is passed along it to the popliteal space, where it is occasionally useful in locating the vein. When it ends in the thigh, appropriate modification is needed.

CONCLUSION

Varicosity of the short saphenous vein is described. In about 65 per cent this is associated with incompetence of 'other' tributaries of the popliteal vein, especially those of gastrocnemius. These mimic short saphenous varicosity, so here they are called 'pseudo-short saphenous veins'. If they are unligated some varicose veins may persist after sapheno-popliteal ligation and stripping. The remedy is exploration of the popliteal vein and ligation of the

faulty vessels; good results have followed in 86 primary cases and 6 recurrent cases. The anatomy, diagnosis, and treatment of the varicose tributaries of the popliteal vein are sketched.

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THE TECHNIQUE OF TOTAL CYSTECTOMY IN THE MALE

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DISCUSSION is still evoked by the place of total cystectomy in the management of patients with bladder cancer: the operative mortality is certainly not less than 13 per cent (Riches, 1957) and palliation rather than cure is often the criterion of success. Hazards of urinary deviation, obligatory when total cystectomy is undertaken, account for some of the post-operative deaths—possibly a majority—but the cystectomy itself undoubtedly contributes significantly. Peritonitis and renal failure are recognized sequelæ of uretero-intestinal anastomosis: deaths ascribed to other causes (Brice, Marshall, Green, and Whitmore, 1956), such as cardiac failure, shock, and collapse, imply excessive blood-loss and operative trauma, complications seldom seen after uretero-intestinal anastomosis alone, and more likely, together with rectal fistula and possibly wound disruption, to be due to the cystectomy rather than the procedures used for the urinary deviation.

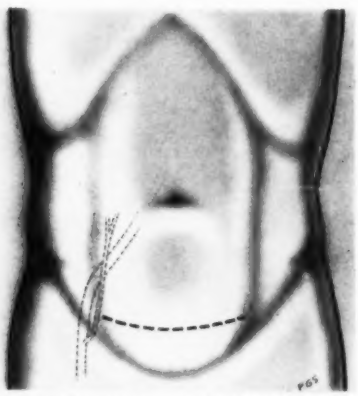

FIG. 606.—Curved transverse skin incision: the recti are divided in the same plane and the deep epigastric vessels are divided and ligated on both sides.

The following description of the operation of total cystectomy emphasizes principles rather than details: with this technique blood-loss and operative trauma are minimal. The method has been developed primarily for two-stage procedures (we prefer to carry out bilateral uretero-intestinal anastomoses three weeks before total cystectomy), but is applicable to a single-stage total cystectomy with uretero-intestinal anastomosis.

THE OPERATION

General anæsthesia with the addition of a relaxant drug is used. The operation is carried out with the patient in a moderate Trendelenburg tilt and supported by pelvic rests.

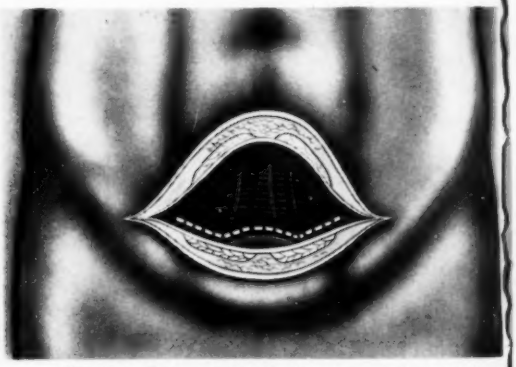

FIG. 607.—The upper flap of skin and muscle is dissected off the underlying peritoneum for approximately 8 cm. and the peritoneal cavity is entered through a transverse incision made close to the bladder fundus.

A transverse skin incision, with a downward convexity, is made across the lower abdomen, extending from the lateral margins of the recti (*Fig.* 606): sheath and muscle are divided in the plane of the skin incision and the deep epigastric vessels are divided and ligated. The upper flap of skin and muscle is dissected off the underlying anterior parietal peritoneum for a distance approximately 8 cm. above its reflexion at the fundus of the bladder and the abdominal cavity is opened by a transverse incision in the peritoneum close to the bladder fundus (*Fig.* 607).

1. Exposure of the Right External Iliac Artery and Vas.—The bowel is packed off and retracted so that the region of the bifurcation of the right common iliac artery and the ureter, transplanted or intact, may be exposed by an incision in the

overlying posterior parietal peritoneum. The whole course of the external iliac artery is followed down to the internal abdominal ring, where the vas is seen, clamped, divided, and ligated (*Fig.* 608). The peritoneal incision is then extended forwards to join the primary transverse peritoneal incision lateral to the fundus of the bladder.

2. Exposure of the Right Internal Iliac Artery and Branches.—From the proximal end of the incision in the posterior parietal peritoneum,

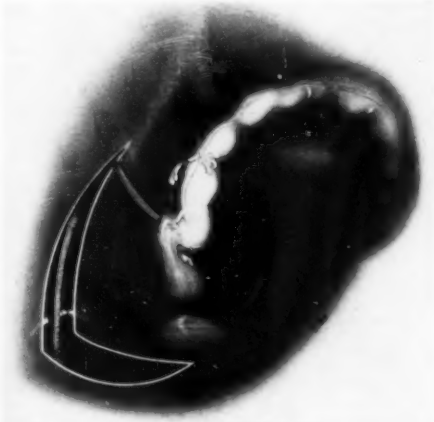

FIG. 608.—Exposure of the right external iliac artery and division of the right vas. The right ureter has been transplanted at a previous operation.

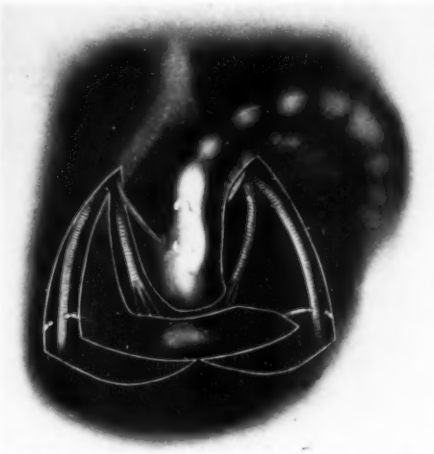

FIG. 610.—Exposure of the left external and internal iliac artery and the anterior visceral branches of the internal iliac after retraction of the sigmoid colon to the right and incision of the peritoneum in the left paracolic gutter.

at the bifurcation of the right common iliac artery, the peritoneum over the right internal iliac artery is incised and the incision is prolonged downwards and medially to reach the midline in the rectovesical pouch (*Fig.* 609): the right ureter is carefully guarded. The trunk of the right internal iliac artery and its anterior visceral branches are exposed by blunt dissection using a moist 'pea-nut swab' in long forceps: the three anterior visceral branches of the anterior division of the internal iliac artery, the superior

FIG. 609.—Exposure of the right internal iliac artery and the anterior visceral branches.

vesical, vesiculo-deferential, and the inferior vesical (Braithwaite, 1952), are each separately encircled by an aneurysm needle before ligation and division. The direction of these visceral branches is forward, downward, and medial, in contradistinction to the lateral and posterior direction of the obturator, internal pudendal, and inferior gluteal—the parietal branches of the anterior division of the internal iliac artery.

3. Exposure of the Left External Iliac Artery and Vas: Exposure of the Left Internal Iliac Artery and Branches.—The sigmoid colon is retracted to the right and the peritoneum of the left paracolic gutter is incised vertically. With the use of a moist swab held in long forceps, the sigmoid colon and its 'mesentery' is swept medially to expose first the left external and then the left internal iliac artery and ureter. As on the right side, the whole course of the left external iliac artery is bared, the vas is divided and ligated, and the peritoneal incision is extended forwards to join the primary transverse peritoneal incision lateral to the fundus of the bladder. The lower part of the posterior parietal reflexion must then be divided in a medial direction (*Fig.* 610) to join the peritoneal incision in the rectovesical pouch coming from the right side: in this way the anterior visceral branches of the anterior division of the left internal iliac artery are exposed, separately ligated, and divided as on the other side.

4. Mobilization of the Bladder.—The previous steps leave the bladder (with small bilateral peritoneal flaps) adherent posteriorly and laterally respectively to the rectovesical fascia and the lateral condensations

of the pelvic fascia (the 'lateral ligaments' of the bladder), and attached distally to the prostatic urethra and prostate.

The rectovesical tissue plane is entered by following down the vasa on both sides: traction on the distal cut ends of the vasa and blunt dissection leads first to the seminal vesicles and then to the

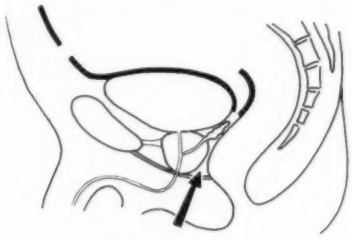

FIG. 611.—Separation of the vesicles and prostate from the rectum: dissection is begun from above and is continued as far as the superior margin of the prostate. The arrow shows the main route which is developed from the superior surface of the urogenital diaphragm.

posterosuperior aspect of the prostate. Deeper dissection at this stage risks injury to the rectum: it is easier to enter the distal part of the rectovesical tissue plane—really the retroprostatic plane of Proust (McGregor, 1943)—by blunt dissection at both lateral margins of the prostate. By keeping close to the posterior surface of the prostate, a firm structure, it is

FIG. 613.—The left side of the anterior parietal peritoneal flap is sutured to the sigmoid colon.

not difficult to develop the correct plane of cleavage and so avoid injury to the adjacent bowel (*Fig.* 611). The puboprostatic ligaments are cut and a strong angled clamp is applied across the prostate at the superior surface of the urogenital diaphragm and the prostate and the prostatic urethra are divided by diathermy to free the bladder from below.

Mobilization is continued by dividing, from above down, the 'lateral ligaments' of the bladder on both sides. Bleeding, mainly venous, is only slight and is temporarily controlled by small packs: there is seldom need to use artery forceps. The technique is simplified by retracting the bladder to one side while the opposite 'ligament' is divided.

The final step is elevation of the clamped prostate with the attached bladder, and severance, for approximately 2 cm., of the remaining adhesion between the anterior wall of the rectum behind and the base of the seminal vesicles and prostate in front.

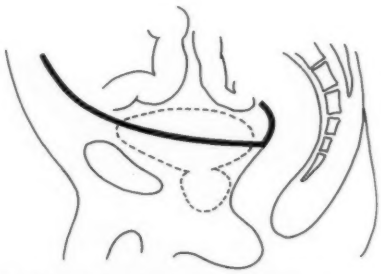

FIG. 612.—Reconstruction of the peritoneum. The long upper flap of anterior parietal peritoneum is sutured to the posterior parietal peritoneum on the right side and to the sigmoid colon on the left. The peritoneal cavity is foreshortened.

5. Hæmostasis.—Once the bladder, with the attached prostate, vesicles, vasa, and (when the ureters have been transplanted previously) distal ends of the ureters, has been removed access is adequate for close inspection of the pelvis. Some bleeding points, mainly venous, may require diathermy coagulation: oozing from the superior surface of the urogenital diaphragm is controlled by sustained pressure on a gauze swab.

6. Reconstruction of the Pelvic Peritoneum and Wound Closure.—The long upper flap of the anterior parietal peritoneum, prepared at the initial stages of the operation after the abdominal recti are divided, is used to restore, by foreshortening, the peritoneal cavity (*Fig.* 612). Starting on the right side and using a continuous No. 0 chromic catgut suture on an atraumatic curved needle, the edge of the proximal end of the medial flap of posterior parietal peritoneum overlying the right internal iliac artery is sutured to the edge of the right side of the anterior parietal flap of peritoneum: it is sometimes necessary to elevate, by dissection, the posterior flap of peritoneum to avoid undue tension. The suture is continued as far as the midline and the transplanted ureter on the right side may be sited to remain outside the reconstructed peritoneal cavity.

From the midline the suture continues to the left, and the left half of the anterior parietal flap of peritoneum is approximated to the left margin of the sigmoid colon (*Fig.* 613): it is impracticable to use the cut edge of the lateral leaf of the sigmoid mesocolon—originally the medial flap of peritoneum of the paracolic gutter. When the sigmoid colon is replaced in the left iliac fossa, the suture picks up the edge of the proximal end of the lateral flap of the posterior parietal peritoneum to complete reconstruction of a foreshortened peritoneal cavity. The left ureterocolic anastomosis is intraperitoneal.

A length of 3-in. gauze is lightly packed in the pelvis outside the reconstructed peritoneal cavity and is brought out through a small counter-incision: it serves to control hæmostasis, effects drainage of serous exudate, and supports the reconstructed

peritoneum. The abdominal wall is repaired by interrupted mattress sutures.

COMMENTS

Although sporadic attempts to treat bladder tumours by total cystectomy have been made for more than fifty years (Shackman, 1947), the operation has been regularly practised only since about 1940 (Sandrey, 1953): and since malignant lesions of the bladder are relatively uncommon and alternative treatments, for example radiotherapy, transurethral resection, and partial cystectomy, have their places and advocates, individual surgeons are unlikely to have acquired extensive specific operative practice. Allowing for exceptions, the specialist urologist is not likely to perform total cystectomy more than approximately six times a year: other surgeons do proportionately less.

Millin and Masina (1949) state that blood-loss is the most important single factor in the operative mortality of total cystectomy, and Paquin and Marshall (1956) stress the need for extensive blood replacement in such circumstances. While the validity of these opinions is not questioned, it is believed that the operation may be completed with minimal blood-loss if early ligation of the anterior visceral branches of the internal iliac arteries, close to their origin, is carried out as described in the present paper. Ligation of the internal iliac arteries (Badenoch, 1953), an alternative procedure, not only risks damage to the adjacent large veins but is unnecessary: proximal ligation of the anterior visceral branches of the internal iliac arteries is preferable since these small vessels conveniently pass forwards from their origin and may easily be encircled by an aneurysm needle without risk of injury to the large veins. Indeed, the main iliac veins seldom intrude into the operative field. When distal ligation of the superior vesical, vesiculo-deferential, and inferior vesical vessels in the perivesical fascia is practised, access is more difficult, and Millin and Masina (1949) refer to the risks of hæmorrhage and injury to the rectum in such circumstances.

Millin and Masina (1949), Badenoch (1953), and Sandrey (1953) all recommend separation of the bladder base and prostate from the rectum by deep dissection from above down after incision of the peritoneum in the rectovesical pouch and exposure of the seminal vesicles. The alternative method, which is preferred, is to enter the retroprostatic tissue plane of Proust (McGregor, 1943) by scissor and finger dissection from both lateral margins of the prostate at the superior surface of the urogenital diaphragm: the posterior surface of the firm gland is an excellent landmark and by dissecting close to the prostate bleeding is negligible and the bowel is easily avoided.

Removal of enlarged lymph-nodes along the iliac vessels, internal or external, is best undertaken after the bladder has been removed, but it is doubtful if the ultimate prognosis is much influenced by this procedure, for it is generally agreed that such dissemination is synonymous with Stage IV of the disease (Dukes and Masina, 1949) when the potential cure rate is very low. Indeed, total cystectomy in such cases is carried out mainly as a palliative, so that dissection *en bloc*, although possibly correct in theory,

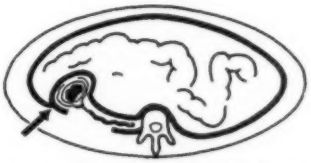

FIG. 614.—Reconstruction of the peritoneal cavity on the left side: the right leaf of the pelvic mesocolon forms the new lower left boundary.

has little to commend it in practice. Such imperfection in technique in this form of cancer surgery is justified.

An extraperitoneal approach to the bladder has no particular virtue: on the contrary, access is easier when the exposure is developed across the peritoneal cavity and, moreover, wide excision of the paravesical peritoneum in continuity with the bladder includes the subperitoneal lymphatic plexus (Jewett and Strong, 1946). Reconstruction of the peritoneum is always advisable after removal of the bladder and is effected by foreshortening of the peritoneal cavity: the long flap of the anterior parietal peritoneum is sutured to the cut edge of the posterior parietal peritoneum on the right side and to the left margin of the sigmoid colon on the left. The right leaf of the sigmoid mesocolon forms the new lower left boundary of the reconstructed peritoneal cavity (*Fig.* 614).

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MUCOSAL STENOSIS OF THE PYLORUS

By JAMES A. RHIND, Pontefract

Hypertrophic pyloric stenosis is a well-recognized condition in the infant. A similar pyloric hypertrophy in the adult has been reported frequently, and it has been suggested that it represents a persistence of the infantile abnormality although there is no convincing evidence to support this suggestion. Recently, Desmond and Swynnerton (1957) have shown that adult hypertrophy is more common than had previously been thought.

Gastric and duodenal ulcers sometimes occur in the same patients, and Daintree Johnson (1955) found that the duodenal usually preceded the gastric ulcer in these patients. He suggested that the gastric ulcer was due to an element of obstruction by the duodenal scarring or ulceration. Goligher, Moir, and Wrigley (1956) were surprised to find gastric ulcers occurring after Billroth I gastrectomy for duodenal ulceration; the suggestion that the gastric ulcer is evidence of some obstruction at the gastroduodenal anastomosis seems acceptable.

Duodenal stenosis by the scarring of ulceration is easily seen on inspection of the duodenum at operation. An hour-glass deformity of the stomach is obvious on the external surface. 'Pyloric stenosis' by scarring is always included in lists of the complications of peptic ulceration; most authors are careful to explain that this is usually a duodenal stenosis, but the impression is left that true pyloric scarring can occur, and Stewart (Hurst and Stewart, 1929) gives an illustration of an example of pyloric scarring which must have been visible as an external constriction. It came as a shock, therefore, to discover gross pyloric obstruction by a mucosal diaphragm without any externally visible or palpable sign of stenosis. A recent series of cases has provoked speculation on mucosal stenosis as a cause of gastric ulceration and pyloric hypertrophy.

Case 1.—**Mucosal diaphragm, with associated gastric ulceration.**

Mary C., aged 38 years, first attended in 1953 with three years' history of dyspepsia; a barium meal showed a pyloric ulcer. The dyspepsia continued and in 1955 the radiograph showed that the pyloric ulcer had disappeared but that there was a new gastric ulcer on the lesser curve. Apart from organic dyspepsia, she had numerous unrelated symptoms of a functional nature. She was considered to be a neurotic individual and operation was thought inadvisable.

In January, 1957, she was still complaining of intermittent pain in the epigastrium, striking through to the back, with a variable relation to eating. There was no vomiting. She was very thin, but no abnormality could be felt inside the abdomen. A barium meal was reported as follows: "The stomach was again hypotonic with excess resting juice. The gastric ulcer near the incisura was smaller than shown in the previous X-ray in 1955; it was conical in shape. The duodenal cap showed normal appearances."

At Operation (Feb. 7, 1957).—On the lower third of the lesser curvature of the stomach there was slight thickening and a dimple could be felt on the mucosal surface of this thickening, corresponding with the ulcer seen on the radiograph. No other abnormality was found inside the abdomen. The gastric ulcer did not seem very impressive, but the long history despite medical treatment was thought to justify operative treatment and a Billroth I gastrectomy was performed.

The specimen was examined at the end of the operation. The stomach did not appear hypertrophied. About 5 cm. from the pylorus, on the lesser curve, there was a flat ulcer about 5 mm. in diameter with the appearance of a healing subacute ulcer. It was not possible to push a finger through the pylorus, and eversion of the duodenal cuff revealed that the passage was impeded by a diaphragm. The attachment of the diaphragm was at the pyloric ring of muscle, which seemed normal in size and stretched over the finger easily. In the centre of the diaphragm there was an aperture having a maximum diameter of 3 mm.; the edge of this aperture was a firm fibrous ring, but the remainder of the diaphragm consisted of soft mucous membrane.

Case 2.—**Mucosal diaphragm with manifest pyloric stenosis.**

Charles P., aged 59 years, was under observation in the chest clinic with quiescent bilateral apical pulmonary tuberculosis. He gave a history of loss of appetite and vomiting for five weeks; there had been no abdominal pain. The stomach outline was visible and peristaltic waves could be seen. The barium meal was reported as follows: "The stomach contained a considerable quantity of residue. It showed vigorous peristalsis but there was no evidence of obstruction. The pylorus and duodenal cap appeared normal."

In hospital, on a fluid diet, his vomiting ceased. His blood chemistry was normal. Repetition of the barium meal confirmed the presence of a large stomach with vigorous peristalsis, but showed no mechanical obstruction, the barium flowing freely into the jejunum.

At Operation (Feb. 2, 1957).—The stomach was large and hypertrophied, especially in the pyloric region. The duodenum appeared normal. Palpation of the pyloric ring between the finger and thumb showed that the ring could be dilated to a diameter of 15 mm. No other abnormality was found inside the abdomen. Gastro-enterostomy was performed, but before the suturing was completed the clamp was taken off the stomach and a finger inserted into the pylorus; a soft obstruction was felt, and this appeared to be a mucosal diaphragm.

He wakened from the anæsthetic and his condition seemed satisfactory. Twelve hours later, however, he suddenly collapsed and died. Post-mortem examination confirmed the presence of hypertrophy of the stomach, the mucosal diaphragm, and the absence of any muscular or fibrous stricture as the cause of the obstruction.

Case 3.—**Mucosal diaphragm with manifest pyloric stenosis, pyloric hypertrophy, and gastric ulceration.**

Martha H., aged 59 years, attended the medical clinic in December, 1955, with a history of flatulent dyspepsia and heartburn for two years. She had lost 3 st. in weight but was still obese (13 st.). A barium meal was reported as follows: "The stomach contained a considerable quantity of residue. The pyloric region showed a narrow canal some 2 cm. long and 0·5 cm. in diameter; this outline appeared persistent. The duodenal cap showed normal appearances. Opinion: Pyloric stenosis ? neoplastic."

At Operation (Jan. 4, 1956).—The œsophageal hiatus in the diaphragm was lax but there was no hernia. There was some thickening of the pylorus, but it was thought that the presence of a carcinoma could be excluded. The duodenum was normal. The gall-bladder was thin-walled,

but many small stones were palpable. Since gall-stones have been suggested as a cause of pylorospasm, the gall-bladder and appendix were removed and the abdomen closed.

She was kept under observation in the out-patient clinic during 1956. She continued to complain of heartburn and eructation, but had no vomiting. If she departed from a strict ulcer diet, she felt discomfort in the xiphisternal region. In February, 1957, she began to vomit large quantities, but appeared very well. A barium meal was reported as follows: "Repeat examination showed marked pyloric stenosis still to be present. The pyloric appearances were the same and there was a large gastric residue after twenty-four hours. Barium was still present in the stomach at forty-eight hours."

At Operation (March 5, 1957).—The stomach was large and hypertrophied. The pylorus was more thickened and could not be invaginated to examine the pyloric ring. The duodenum was normal. Partial gastrectomy was performed.

The specimen was examined at the end of the operation. There was a subacute gastric ulcer on the lesser curve. A finger could be pushed from the stomach along the pyloric canal as far as the pyloric ring where it was stopped by a diaphragm. The pyloric ring could be stretched to a diameter of 1 cm. around the attachment of this diaphragm, which had a central aperture about 3 mm. in diameter when stretched. The mucosa of the pyloric canal was thick, indurated and red.

In each of these three specimens the diaphragm of mucous membrane was attached exactly at the pyloric ring with duodenal mucosa on one side and gastric mucosa on the other. In the following case the diaphragm was attached about 2 cm. proximal to the pyloric ring, although it resembled the others in that it appeared to consist only of mucous membrane and there was no obvious external deformity of the stomach.

Case 4.—**Mucosal diaphragm in pyloric antrum, with associated gastric ulceration.**

James C., now aged 70 years, first attended in 1940 with six years' history of painful dyspepsia without vomiting. A barium meal was reported as follows: "Stomach J-shaped, orthotonic type; active but irregular peristalsis. Emptying somewhat delayed by intermittent spasm. The duodenal cap showed fairly marked intermittent spasm which, however, was fairly persistent along the left base adjacent to the pylorus. Opinion: Although not definite, the appearances are suggestive of a small acute duodenal ulcer, associated with a fairly marked degree of gastritis."

In 1945 he had an exacerbation of symptoms and a barium meal was reported as follows: "Stomach medium sized with good tone and very active peristalsis. Some residual fluid and irregular thickening of the gastric rugæ. Probable ulcer niche on the upper third of the lesser curve. The duodenal cap seemed of large size, with persistent spastic deformity; ulcer niche not demonstrated. Opinion: Appearances suggest duodenal ulcer, with associated gastric ulcer on the upper third of the lesser curve and well-marked gastritis."

He attended my clinic in July, 1956, when he complained of occasional epigastric pain, heartburn, and vomiting of fluid. His longest free period from symptoms was six months. The barium meal was reported as follows: "The stomach showed evidence of gastritis with gastric erosions on the lesser third within the pylorus. There was also an ulcer crater about 1 cm. in diameter in the antrum. The duodenal cap showed marked deformity with ulcer diverticulum formation. Opinion: Chronic gastric and duodenal ulceration."

In view of his age and chronic bronchitis, he was advised to take a milk diet with rest in bed. In September he reported freedom from symptoms and a barium meal showed improvement in the stomach, although an ulcer crater was still visible. In January, 1957, he was referred to the hospital again with burning pain in the epigastrium and vomiting of fluid, usually in the middle of the night.

At Operation (Feb. 6, 1957).—The œsophageal hiatus in the diaphragm appeared normal. The stomach was large, and the thickening of ulceration was felt on the lower part of the lesser curvature. There was a scar on the first part of the duodenum with typical pouching on the upper and lower borders, but there was no active duodenal ulceration and no stenosis. No other abnormality was found inside the abdomen, and partial gastrectomy was performed.

Fig. 615.—Diagrammatic representation of the pyloric region, to show that the size of the diaphragm depends on the state of contraction of the pyloric muscle. The submucous tissue is very lax and sliding can easily occur.

The specimen was examined at the end of the operation. On the lower part of the lesser curve there were two shallow ulcers about 1 cm. apart, with submucosal thickening extending for about 2 cm. from the edge of the ulcers. About 2 cm. from the pyloric ring, and about the edge of the thickened area on the lesser curve, there was a diaphragm across the pyloric antrum. A finger could be inserted through the duodenum and the pylorus as far as this diaphragm, which felt soft and seemed to consist of mucous membrane only; there was a central aperture with a rounded edge and a maximum diameter of 3 mm. when the diaphragm was stretched on the tip of the finger. The proximal surface of the diaphragm and the neighbouring mucosa were redder than normal, suggesting an acute gastritis.

Review of the X-ray films of 1956 showed that this diaphragm had been mistaken for the pylorus. The 1940 and 1945 X-ray films were not available for comparison, and it is impossible to be certain when the diaphragm appeared, although the 1945 report suggests that it was present then.

Each of these four specimens in the fresh state showed an obvious diaphragmatic stenosis of the pyloric mucosa, although the enclosing fibromuscular tube could easily be stretched to a normal calibre.

After fixation in formalin, the preparations were very disappointing; the muscle contracted and the diaphragm almost disappeared (*Fig.* 615). Doubtless this is the condition in the body, the diaphragm being prominent only when the pylorus is dilated. Attempts at packing the lumen during fixation, including stitching the duodenal cuff over a mould of cotton-wool, were not successful in displaying the diaphragm.

FIG. 616.—*Case* 5. Mucous membrane lining the gastro-duodenal region (duodenum left, stomach right).

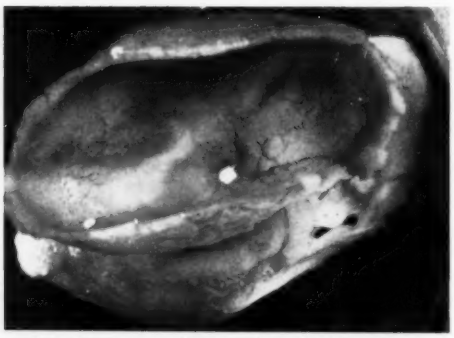

FIG. 617.—*Case* 5. Interior of the duodenal mucosa, to show the size of the mucosal pylorus seen as the central aperture.

It was decided, therefore, to separate the mucosa and the muscle, and this was done in the next case.

Case 5.—**Mucosal diaphragm with manifest pyloric stenosis.**

Horace F., aged 47 years, attended the medical clinic with a history of vomiting for one month. He had lost 1 st. in weight during the past year. He had had indigestion all his life, but had never consulted a doctor for this. A barium meal showed gross pyloric delay, but the cause could not be demonstrated.

He was admitted to hospital and given a fluid diet. A stomach wash showed only 4 oz. of residue and his blood chemistry was normal.

AT OPERATION (Sept. 25, 1957).—The stomach was large and hypertrophied. The pyloric region was thickened, but could be invaginated so that a finger and thumb could be apposed through the pyloric ring, which felt normal. The duodenum showed no sign of past or present ulceration. No other abnormality was discovered, and partial gastrectomy was performed.

The specimen was examined at the end of the operation. There was obvious muscular hypertrophy of the whole of the stomach. A finger was passed through the stomach to the pyloric ring, which could be stretched to a diameter of 1 cm. Filling this was a diaphragm of soft mucous membrane with a central aperture about 2 mm. diameter. The mucosa was then dissected from the muscle; this was not very easy in the duodenal cuff, although there was no submucous scarring; in the stomach little more than blunt dissection was required; at the upper part of the pyloric ring there was dense fibrous tissue in the submucosa requiring careful sharp dissection– the remainder of the pyloric ring separated easily by dissection. The two mucosal surfaces of the diaphragm separated partially during the dissection, being held together only by a filmy tissue. After separation, a finger could be passed easily through the muscular pylorus, but the mucosal pylorus remained 2 mm. diameter (*Figs.* 616 618).

The mucosal diaphragm was examined histologically. On the greater curvature side the transition from gastric to duodenal mucosa took place near the base of the diaphragm, both sides of which were covered by gastric mucosa. On the lesser curve the transition took place at the central edge of the diaphragm, where there was an epithelial scar and a tiny ulcer; submucous scarring was prominent in this part of the diaphragm (*Figs.* 619, 620).

The cause of these diaphragms is not immediately obvious. A congenital origin, similar to the diaphragm occasionally found in the second part of the duodenum, seems impossible because of the age of

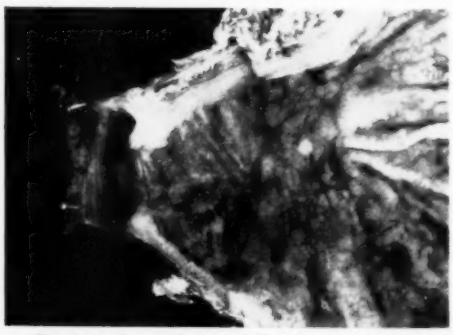

FIG. 618.—*Case* 5. Posterior half of the stomach which has been divided along the curvatures. The area from which the mucosa has been taken (*Fig.* 616), and the size of the muscular pylorus, can be seen.

these patients. A chronic peptic ulcer involves the submucosa and muscle, and a contracting scar will therefore involve these tissues. Duodenal stenosis from a healed duodenal ulcer is a narrowing which is easily seen on the outside of the duodenum. An hour-glass stomach is a deformity affecting all layers of the wall of the stomach. Is it possible for the scarring of peptic ulceration in the pylorus to cause such contraction of the mucous membrane as to produce a diaphragm without fixation to the muscle which remains of normal size? Is the powerful pyloric muscle able to resist the deforming action of scar tissue? Or are these diaphragms the scars of superficial ulcers of the pylorus, the contraction of the scar tissue being facilitated by the support of the

closed pyloric ring? The following cases lend support to this last postulate (*Fig.* 621).

Ernest H., aged 36 years, attended the medical clinic in 1954 with a history of epigastic pain after meals for ten months. The radiologist reported that a barium meal showed gastroduodenitis.

He attended the surgical clinic in 1957. He had been having medical treatment since 1954, with periods of freedom from symptoms for as long as two months. His pain was still felt in the epigastrium before meals and

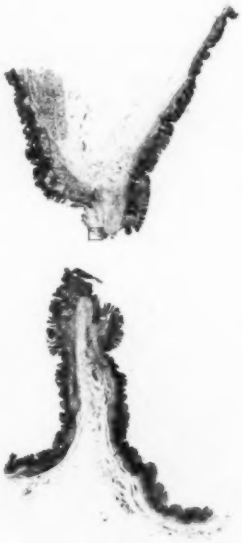

FIG. 619.—*Case* 5. Stained section of the mucosal preparation, showing that it consists only of the mucous membrane, muscularis mucosæ, and submucous tissue. Note the concentration of fibrous tissue around the central aperture, more marked on the lesser curve side (duodenum left, lesser curve above).

thickening of the pylorus. The stomach was opened and a finger passed inside felt a tiny ulcer crater on the lesser curve at the pylorus. In view of the history, partial gastrectomy was performed.

The specimen was examined at the end of the operation. It was just possible to pass a finger through the pylorus. The specimen was everted. There was a linear ulcer (like an anal fissure) exactly on the junction of the gastric and duodenal mucosae. It was on the line of the lesser curve but at right angles to it, running along the pyloric ring which perhaps felt harder than normal.

Case 6.—**Partial mucosal diaphragm with pyloric ulcer and associated gastric ulceration.**

John R., aged 60 years, first attended in May, 1956, with a history of epigastric pain ten minutes after eating, for the past two years. He had lost 2 st. in weight. A barium meal was reported as follows: "The stomach contained considerable residue and was slow to start

FIG. 620.—*Case* 5. Higher magnification of part of the lesser curve free edge of the diaphragm (indicated in *Fig.* 619). The new epithelium has become detached from the underlying granulation tissue at the edge of the tiny ulcer.

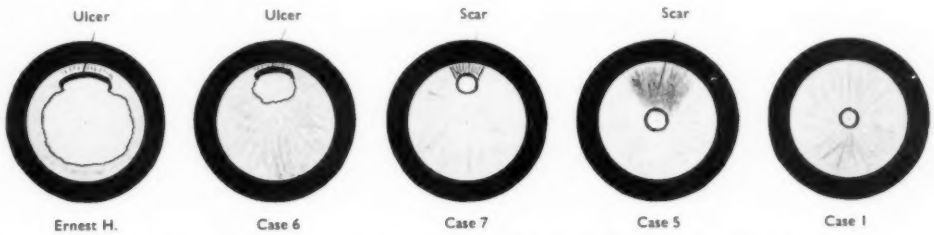

FIG. 621.—Diagrammatic representation of a cross-section through the pylorus, showing the pyloric muscle and postulated successive stages in the formation of a diaphragm with a central aperture.

wakened him at night; it was relieved by milk. There was frequent vomiting during the attacks. The barium meal showed little alteration in the general appearance of the stomach and duodenum, but there was now an ulcer crater about a ¼ cm. in diameter at the pylorus. Bed rest with milk was advised, but he reported no relief after three weeks.

AT OPERATION (Feb. 27, 1957).—The stomach and duodenum appeared normal except for a very doubtful emptying. There was an area about 3 cm. long in the pyloric region in which outlines were not shown other than a small prepyloric ulcer crater which was well-defined and about 0·5 cm. in diameter. The unseen area may be spasm or neoplasm."

Strict medical treatment was advised. He returned in July and said that he was no better despite rest in bed with a milk diet. The radiologist reported that a further barium meal was very suggestive of neoplasm.

At Operation (July 18, 1956).—There was perhaps a little thickening of the pyloric region, but this did not seem sufficiently convincing to justify gastrectomy. No other abnormality was discovered, and the abdomen was closed after removing the appendix.

He was re-admitted to hospital in October, 1957, as an emergency with vomiting and black stools. Since the operation he had had intermissions for as long as two months, and attacks of about the same duration. During the attack he had epigastric pain and vomiting and lost weight, which he regained in the periods of freedom. He appeared well, and the stomach outline was not visible. A barium meal was reported as follows: "The stomach contained a moderate amount of juice. The main body showed evidence of gastritis, but otherwise normal appearances. There was a small ulcer in the region of the incisura. The antral region was narrowed and irregular in outline but filled out better than in 1956. There was a small ulcer crater on the lesser curvature almost at the pylorus. The duodenal cap showed slight deformity of outline but no ulcer crater was seen."

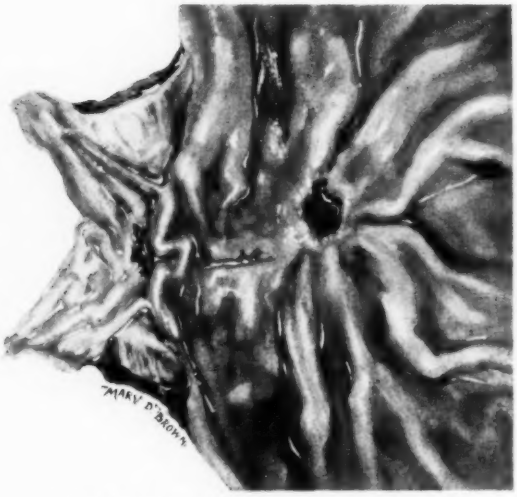

Fig. 622.—*Case* 6. Artist's drawing of the gastrectomy specimen, opened along the greater curve. The linear ulcer is seen to be at the gastroduodenal junction. Note the discrepancy between the narrow mucous membrane and the pyloric muscle, which was normal in size. A chronic gastric ulcer is visible on the lesser curvature of the stomach.

At Operation (Nov. 5, 1957).—The stomach was larger than normal, but not obviously hypertrophied. About 2 in. from the pylorus there was a chronic gastric ulcer with a palpable crater. The pylorus was a little thickened and red, but a finger and thumb could be apposed easily through the pyloric ring. There were fine scars on both the anterior and posterior walls of the duodenum, but no pouching or other deformity of the duodenum. Partial gastrectomy was performed.

The specimen was examined at the end of the operation. The palpable ulcer was about 1 cm. in diameter and depth, and was a typical chronic gastric ulcer. There were two tiny ulcers on the lesser curve between this ulcer and the pylorus. It was not possible to pass a finger through the pylorus, although the pyloric ring was easily stretched to a diameter of more than 1 cm.; the obstruction was by a diaphragm of mucous membrane attached at the pylorus, with an aperture of about 4 mm. diameter. This differed from the other diaphragms in that the aperture was not central but on the lesser curve, where there was an ulcer about 2 mm. wide extending for about 4 mm. around the pylorus (*Figs.* 622, 623).

Case 7.—**Mucosal diaphragm in the pyloric antrum, with associated gastric ulceration.**

Frederick M., aged 54 years, attended the medical clinic in 1952, with eighteen months' history of epigastric pain after food and occasional vomiting. A barium meal revealed an ulcer, 1 in. in diameter, at the middle of the lesser curvature of the stomach. He responded slowly to medical treatment, a second radiograph showing a shallow ulcer and a third (after five months) no active ulceration. Each of these three barium meals showed evidence of gastritis, and the pyloric canal was consistently elongated, although there was no delay in emptying.

In 1956 he was admitted to hospital with severe pain and vomiting. These symptoms were considered to be due to an exacerbation of his ulcer, and quickly subsided in hospital. Out-patient observation was arranged, but he did not attend. It seems that he was reasonably comfortable on his diet, but any departure provoked pain and vomiting. He was re-admitted to hospital with a hæmatemesis on Dec. 22, 1957. Despite medical measures, the bleeding continued and on Dec. 24 he vomited a pint of fresh blood.

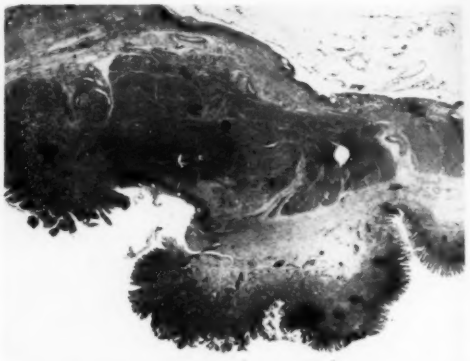

Fig. 623.—*Case* 6. Stained section of the pyloric region, to show the ulcer on the pyloric ring at the transition from gastric to duodenal mucous membrane. (× 3·3.)

At Operation (Dec. 24).—There was a gastric ulcer, about 1 in. in diameter, about the middle of the lesser curve. A nodule palpable in the base of the ulcer suggested clot around the end of a vessel (this suggestion was confirmed when the specimen was examined later). The stomach and the first part of the duodenum were large, thickened, and œdematous. It was a little more difficult than usual to stretch the pyloric ring so that a finger and thumb could be apposed through it. There was no external narrowing of the pylorus, and it seemed that the thickening was simply part of the general thickening of the stomach. There was no sign of past or present ulceration in the duodenum. Partial gastrectomy was performed.

The specimen was examined at the end of the operation. A finger could be passed from the duodenum through the pylorus, but a diaphragm was then encountered. The aperture in this diaphragm was about 2 mm. in diameter and was almost at the point of attachment to the lesser curve, where there was a plaque of firm fibrous tissue. The edge of the aperture felt even firmer and thicker than in the previous specimens. On the lesser curve the diaphragm was firmly fixed about 5 mm. from the pylorus,

but on the greater curve the diaphragm was soft and a finger could be pushed from the duodenum at least 1 cm. through the pylorus; when a finger was passed from the stomach the diaphragm was pushed against the pyloric ring, suggesting that the diaphragm was sliding freely on the greater curvature.

The mucous membrane was dissected from the inside of the muscle. There was no submucous scarring in the duodenum. The dissection in the submucous plane of the stomach was easy except at the attachment of the diaphragm on the lesser curve, where there was very dense

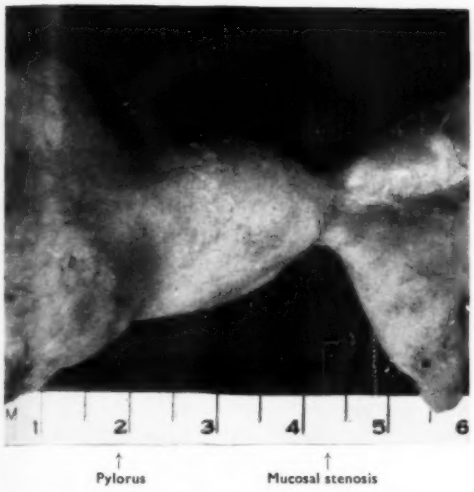

FIG. 624.—*Case* 7. Mucous membrane lining the gastro-duodenal region (duodenum left, stomach right).

fibrous tissue. The resulting specimen of mucous membrane (*Fig.* 624) showed the position of the pylorus clearly as a slight groove and by the change from the rough submucous tissue of the duodenum to the smooth submucous layer of the stomach: this pylorus fitted closely around a finger, as did the pyloric canal for about 1 cm. before the diaphragm was encountered. The diaphragm had separated on the greater curvature side, but the size of the aperture remained unchanged. The fibromuscular tube allowed the passage of a finger easily; on section (after fixation in formalin), the muscular layer appeared about twice the normal thickness.

On review of the X-ray films taken in 1952 it was immediately obvious that the mucosal stenosis seen in the specimen gave a perfect explanation of the abnormal appearance of the pyloric region. It seems certain that a mucosal diaphragm was present in 1952, although it is impossible to estimate the size of the aperture at that time.

DISCUSSION

It is tempting to arrange these cases in the order shown in *Fig.* 621. First there is the linear ulcer seen in Ernest H., with a pylorus of normal size. With the passage of time, alternate healing and extension of the ulcer draw the mucous membrane up to the fixed base, this process being facilitated by the compression of the mucous membrane within a closed pyloric ring. This will produce a small aperture on the lesser curve, still with active ulceration (*Case* 6). When the ulcer heals, the aperture is still fixed to the lesser curve (*Case* 7). As particles of food become impacted in the aperture, the muscular contractions forcing the food onward will tend to stretch the scar tissue so that the aperture is moved towards the centre of the diaphragm; the scar tissue may still be recognized (*Case* 5) or there may be no appreciable scar tissue in the diaphragm (*Case* 1) except the firm fibrous edge of the aperture.

With this hypothesis, the time factor requires further consideration. Ernest H. had painful dyspepsia for four years, yet there was no constriction of the mucous membrane. The diaphragm had been present in *Case* 7 for at least five years, but the mucosal aperture was still firmly fixed to the lesser curve. In *Case* 2, where the diaphragm was fully formed with a central aperture, there was no history of painful dyspepsia preceding the symptoms of pyloric stenosis. There are, however, other variables to consider—namely, the depth of ulceration and the dietetic response of the patient. A superficial ulcer, with a fluid diet requiring little relaxation of the pylorus, might heal promptly and yet produce mucosal stenosis; with little submucous scarring, a diaphragm with a central aperture would soon be formed. With deeper and more chronic ulceration, dense fibrous tissue in the submucous scar might be completely resistant to stretching and the aperture would remain at the periphery of the diaphragm. With a coarse unmasticated diet the pylorus might be continually dilated, preventing mucosal contraction. Considering these factors, it seems credible that mucosal stenosis may progress at different rates, and with different symptoms in different individuals.

The cause of the initial pyloric ulcer is a matter of speculation. Two cases (*Cases* 4 and 6) had the scars of duodenal ulceration, suggesting that the ulcer diathesis plays some part in the production of pyloric ulcers. In this connexion it is interesting that Desmond and Swynnerton (1957) found 6 duodenal ulcers in their 25 cases of adult hypertrophy of the pylorus, an association which they were unable to explain. In 6 of my cases (*Cases* 1, 2, 3, 5, 6, and Ernest H.) the ulcer or diaphragm was exactly at the pyloric ring, where the mucosa is perhaps more liable to be abraded by coarse food or torn by a large bolus. Failure of muscular co-ordination would increase this risk of trauma, and a mechanical cause of pyloric ulcers cannot be excluded at this stage of our knowledge.

Review of the X-ray films with the knowledge of the findings at operation did not reveal any sign which might suggest the presence of a diaphragm at the pylorus. In the ordinary barium meal, using a fluid medium, the pylorus is contracted most of the time, relaxing occasionally to permit a jet of barium to enter the duodenum; such a jet could pass through a 2–3-mm. opening in the diaphragm and could not be distinguished from the jet produced by slight relaxation of the pyloric ring. Wide relaxation of the pylorus would be required to display mucosal stenosis, and this is not a normal event in a barium meal. These considerations do not apply to *Case* 4, where the diaphragm was at the proximal part of the pylorus. Review of these X-ray films, using the ulcer as a fixed point of reference, showed that the diaphragm had been mistaken for the pylorus, which itself was interpreted as a deformed duodenal cap; the duodenal cap proper was very deformed by old

ulceration and difficult to recognize. This appearance of a double duodenal cap has been reported by the radiologist in subsequent cases, but exploration has not discovered any other diaphragms in this situation and it is assumed that this appearance can be produced by spasm.

At operation I have not found it possible to recognize mucosal stenosis by external examination of the pylorus. In my opinion a diaphragm was already present at the first operation, when the pyloric abnormality seemed trivial, in both *Cases* 3 and 6. In these cases the severity of the pyloric lesion was not suspected until manifest pyloric stenosis developed (*Case* 3) or a chronic gastric ulcer appeared in the body of the stomach (*Case* 6). If the duodenum and prepyloric region of the stomach are normal they can be invaginated so that a finger and thumb can be apposed through the pyloric ring; this is normally closed, but it can be stretched to a diameter of at least 1 cm.; a diaphragm is a thin soft structure which would hardly be palpable during this examination. To exclude the presence of a diaphragm it would be necessary to open the stomach or duodenum and pass a finger through the pylorus. It is interesting that the pylorus remains closed after gastrectomy. In some cases the stomach can be filled with water and held up without leakage through the pylorus. If the specimen is fixed in formalin in this state, mucosal stenosis may easily pass unrecognized. In the fresh specimen, however, the normal pyloric ring dilates readily to permit the passage of an index finger.

Four cases presented with gastric ulceration. One (*Case* 1) had no history of vomiting. The others (*Cases* 4, 6, and 7) had periodic attacks of pain and frequent vomiting, suggesting activity of the ulceration rather than obstruction. Only *Case* 7 showed obvious hypertrophy of the stomach. It is surprising that a severe degree of mucosal stenosis can exist without obstructive vomiting or obvious hypertrophy of the stomach. Perhaps the explanation lies in the dietetic treatment of peptic ulceration, all food being suitable for reduction to a liquid chyme in the stomach. After the first 2 cases (*Cases* 1 and 4) it was thought that mucosal stenosis might be a common cause of gastric ulceration; since then, however, a normal pyloric canal has been found in several stomachs removed for gastric ulceration.

Three cases presented with the large vomits typical of pyloric stenosis. On a fluid diet all stopped vomiting, and it seems obvious that an aperture of 2–3 mm. is adequate for the evacuation of the fluid contents of the stomach. Powerful contractions of the pyloric antrum will be required to force fragments of undigested food through an opening of this size, and hypertrophy can be expected. This hypertrophy was observed in *Case* 3, where definite thickening of the pyloric end of the stomach occurred between the two operations.

Most of these specimens showed some thickening of the pylorus, but in no case did the pylorus resemble the pyloric tumour of infantile stenosis, even when persisting into adult life after gastro-enterostomy (Armitage and Rhind, 1951). Desmond and Swynnerton (1957) made the diagnosis of adult hypertrophy of the pylorus when the thickness of the pyloric muscle was 1 cm. or more. Professor Stewart (Armitage and Rhind, 1951) reported that the pyloric portion of the stomach showed great muscular hypertrophy when the muscle was 7 mm. in thickness; the pyloric canal had been packed out to a diameter of approximately 1 cm. before fixation, and it seems obvious that the thickness of the pyloric muscle diminishes as the pyloric canal is expanded. Since most of my specimens were stretched and fixed before the muscle was cut, it is impossible to say which, if any, of these cases could be called 'adult hypertrophy of the pylorus', although hypertrophy was obviously present in some.

Desmond and Swynnerton found mucosal stenosis in 3 of 25 cases of adult hypertrophy. In their cases the pyloric canal was explored only with a probe before the specimen was opened (Desmond, 1957). Perhaps the degree of hypertrophy in their cases would prevent the passage of a finger, but without this examination mucosal stenosis may easily escape recognition. Until this examination is made regularly it seems impossible to say how many cases of adult hypertrophy are due to mucosal stenosis.

Gastrectomy is the usual treatment for a gastric ulcer, and gastro-enterostomy for pyloric stenosis. The presence of a diaphragm calls for further consideration. There is a strong suspicion that gastric retention from stenosis produces gastric ulceration; if this is accepted, it seems logical to treat all diaphragms by gastro-enterostomy, the presence of a gastric ulcer being irrelevant. The cause of a diaphragm is uncertain, but the healing of an annular ulcer seems the most likely explanation; if so, perhaps this is an expression of an ulcer diathesis and requires gastrectomy rather than gastro-enterostomy. As will have been seen, my choice is gastrectomy except when the general condition of the patient requires a lesser procedure.

SUMMARY

Seven cases of diaphragmatic mucosal stenosis of the pylorus are reported. Four presented with gastric ulceration, the other three having symptoms of pyloric stenosis. It is suggested that the diaphragm is produced by scarring from annular ulceration of the pylorus, and that adult hypertrophy of the pylorus will eventually develop.

I would like to thank Drs. A. M. Fraser and E. L. Simons for the radiology, pathology, and photography; and Miss Mary Brown for the coloured illustration.

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SHORT NOTES OF RARE OR OBSCURE CASES

RUPTURED MYCOTIC ANEURYSM OF THE SUPERIOR MESENTERIC ARTERY

By R. E. HORTON

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De Bakey and Cooley reviewed the literature of superior mesenteric artery aneurysm in 1953. At that time they were able to collect 65 cases including one of their own. The most common site for intra-abdominal aneurysm is the abdominal aorta and the superior mesenteric is rarely involved. However, when mycotic aneurysm is considered it is found that the superior mesenteric is commonly involved, and of the 65 cases of aneurysm of the superior mesenteric artery collected by De Bakey and Cooley, 41 (63 per cent) were mycotic, 9 syphilitic (14 per cent), and 15 (23 per cent) were unspecified.

Mycotic aneurysms are frequently multiple and in a series of 217 cases analysed by Stengel and Wolferth in 1923 multiple lesions were found in 22 per cent. This is also borne out by recent reports of surgically treated patients, all of whom had other episodes of embolus or aneurysm (*Table I*).

Table I.—Mycotic Aneurysm of Superior Mesenteric Artery Published Cases treated by Surgery

Date	Case	Aetiology	Other Lesions	Treatment
1953	De Bakey and Cooley	Bacterial endocarditis	Multiple emboli	Resection of aneurysm and superior mesenteric vein
1954	West	Unspecified	External iliac artery aneurysm	Aneurysmorrhaphy
1957	Katz and Jacobson	Bacterial endocarditis	Subclavian embolus	Resection of aneurysm and non-viable small intestine
1957	Horton (present case)	Bacterial endocarditis	Cerebral embolus	Resection of aneurysm and ileocolic resection

TREATMENT

Study of the cases in the literature discloses that the prognosis of untreated mycotic aneurysm of the superior mesenteric artery is exceedingly poor and, in fact, most case reports are autopsy studies; the mortality is due to the generalized disease or to rupture of the aneurysm. Now that bacterial endocarditis, which is the usual cause of mycotic aneurysm, can be successfully treated, it is likely that more patients will survive to suffer from mycotic aneurysms and that these will be an increasing problem in the future. In view of the high recorded incidence of rupture, surgical treatment is indicated as an elective operation when the general condition permits and in all cases of rupture.

Experience with ruptured aneurysm of the abdominal aorta has shown that, although the event may be catastrophic and rapidly fatal, it is at times limited to an extensive retroperitoneal hæmatoma, and bleeding may even be completely arrested for a time. Ruptured aneurysm of the abdominal aorta is by no means an insuperable surgical problem, and many such patients treated by resection and graft have survived. The technical problems when the superior mesenteric artery is involved are considerably easier.

Three cases of aneurysm of the superior mesenteric artery have now been successfully treated by surgery. Two of these, including the first case described by De Bakey and Cooley, were undoubtedly mycotic, but the third was of doubtful aetiology. A fourth case is now described in which the aneurysm was manifested by retroperitoneal rupture. An emergency laparotomy made on a tentative diagnosis of acute appendicitis showed a leaking aneurysm to be present. Bleeding had stopped and an elective operation was performed 12 days later.

CASE REPORT

F. S., a bricklayer aged 31 years, was admitted to hospital in January, 1957, with a few months' history of tiredness and malaise. In November, 1956, he developed painful swollen metacarpophalangeal joints of the right hand which lasted a few days, and later he had fleeting pains involving the right ankle, left hand, and shoulder. In early January, 1957, he experienced severe stabbing pain under the left costal margin.

Examination showed him to be febrile with a collapsing pulse and a soft diastolic aortic murmur. The blood-pressure was 130/60 mm. Hg. The spleen was enlarged.

Blood-culture showed that *Streptococcus viridans* was present in the blood-stream. A diagnosis of subacute bacterial endocarditis was made and treatment with penicillin started in a dosage of 1 mega unit followed by 500,000 units 6-hourly. The day after treatment with penicillin was begun the patient developed signs of a small cerebral embolus and the dose of penicillin was

increased to 1,000,000 units 6-hourly for 10 days. A total of 103·5 million units of penicillin had been given by the fortieth day of antibiotic treatment when he began to complain of lower abdominal pain. This became fairly severe and was associated with tenderness and guarding in the right iliac fossa. A diagnosis of acute appendicitis was made. The abdomen was explored and a pulsating mass about 5 cm. in diameter was found in the region of the right common iliac artery. There was a considerable

FIG. 625.—Operation specimen showing position of mycotic aneurysm.

amount of extravasated retroperitoneal hæmorrhage. A diagnosis of ruptured aneurysm of the right common iliac artery was made and the abdomen closed. Antibiotic treatment was continued with 500,000 units of penicillin and 0·5 g. of streptomycin 6-hourly. An interval of 12 days was allowed before the abdomen was re-opened as the symptoms were lessening.

AT OPERATION (March 12th, 1957).—The abdomen was opened through a right paramedian incision. There was a retroperitoneal lump in the right iliac fossa in the angle between the terminal ileum and ascending colon. Very slight pulsation was present and the mass, which was about 5 cm. in diameter, was firm in consistency. There was some retroperitoneal extravasation of blood, and the general appearance was that of an aneurysm with evidence of recent rupture and retroperitoneal leak and a considerable degree of thrombosis within the sac. It was soon evident that the aneurysm was arising from the ileocæcal branch of the superior mesenteric artery and not from the right common iliac artery. It appeared that the most convenient and safe method of ridding the patient of his aneurysm was by doing a right hemicolectomy (*Fig.* 625). This course was followed and an end-to-end ileocolostomy was done.

There was no particular post-operative incident but he received a further 42,000,000 units of penicillin and 42 g. of streptomycin and was discharged 23 days after the resection. He made a full recovery and returned to work, although not to his former trade of bricklaying, but he was able to return to fairly heavy work which did not require him to use a ladder.

DISCUSSION

When the treatment of mesenteric artery aneurysm is considered it is clear that it is determined by the site of the lesion and the collateral circulation. Laminated clot forming in an aneurysmal sac may gradually occlude mesenteric branches and lead to the gradual formation of a collateral circulation. When this has not happened sudden ligation is certain to result in gangrene of bowel.

When the aneurysm is situated proximally on the mesenteric artery the danger to the bowel is maximal. In De Bakey and Cooley's (1953) case it was situated just below the pancreas. Temporary circulatory arrest with a proximal ligature was used to see if the collateral circulation was adequate. No change took place in the colour of the bowel so that it was deemed feasible to excise the aneurysm. In West's (1954) case the danger to the intestine was considered too great and aneurysmorrhaphy was performed.

In the third case, that of Katz and Jacobson (1957), excision of the aneurysm resulted in extensive intestinal ischæmia and four-fifths of the jejunum had to be resected.

In the case recorded here the problem was much less difficult as the aneurysm was situated on a peripheral branch, probably the ileocolic artery, and formal ileocolic resection was the obvious operation of choice.

SUMMARY

A case of ruptured aneurysm of the superior mesenteric artery is described. Three previous cases of mesenteric aneurysm have been successfully treated by surgery; this is the first published example of an aneurysm successfully treated after being complicated by rupture.

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RELIEF OF FLUSHING AFTER RESECTION OF A SECRETING ARGENTAFFINOMA

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It is only in very recent years that the syndrome caused by the endocrine activity of metastatic argentaffinomas or carcinoids has been recognized (Biörck, Axén, and Thorson, 1952). In nearly all the reported cases the metastases were hepatic and there have been few opportunities of observing the cessation of endocrine activity after removal of a tumour mass (Thorson, Biörck, Björkman, and Waldenstrom, 1954, reported such a patient).

The present case is described because the symptoms disappeared after the removal of a large mass of mesenteric nodes which were the seat of an argentaffinoma from a primary in the mid-ileum.

CASE REPORT

A man aged 36 years was seen by his own doctor in January, 1958, on account of vague abdominal discomfort. He found a large abdominal tumour and referred the patient to hospital. There the combination of a peculiar type of facial flushing and an abdominal tumour led to the suspicion of metastasizing carcinoid and the following history was obtained: For nineteen years, since the age of 17, he had been subject to flushing attacks, which he had come to accept as normal and inevitable. Over the first fifteen years or so the attacks increased in frequency, from perhaps one a week to six or seven daily. They would be precipitated by eating food or drinking hot tea. He did not drink alcoholic beverages. Attacks might also be precipitated by embarrassment. During the two or three years prior to his admission to hospital the attacks had appeared to diminish somewhat in number. Each

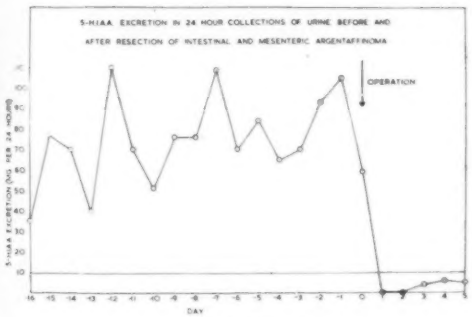
5-HIAA EXCRETION IN 24 HOUR COLLECTIONS OF URINE BEFORE AND
AFTER RESECTION OF INTESTINAL AND MESENTERIC ARGENTAFFINOMA
OPERATION
DAY

FIG. 626.

attack resembled the one which will presently be described.

For about twelve months before his admission he had noticed other symptoms, which were very mild and had not interfered with his work or his pleasure. They were: three or four attacks of watery diarrhœa, the bowels being open 4 6 times daily for a day or two; abdominal swelling, which he put down to "middle-aged spread"; and mild attacks of abdominal discomfort, ill-localized and not apparently related to any natural activity. It was one of these last attacks which finally took him to see his doctor.

Apart from these symptoms the patient felt extremely well. His weight was steady, his appetite good, his exercise tolerance normal.

The outstanding feature on examination was the patient's facial complexion, which during a flush showed a profound brick-red hue, with small blue-white patches

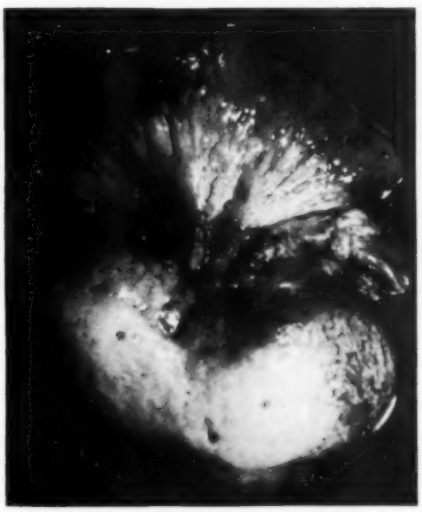

FIG. 627.—The excised specimen. The large mass of mesenteric nodes and the inconspicuous primary tumour of the ileum are seen. (×⅓.)

on the cheeks and sides of the nose. The erythema extended to the collar line, but no further. Between attacks his complexion was not normal, a dusky mottled red colour being imparted to it by the presence of numerous telangiectases, especially on the cheeks.

Signs of pellagra or other vitamin deficiencies were lacking and the patient was well built and well covered. The blood-pressure, which was recorded daily, varied from 120 to 140 mm. Hg systolic and 80 90 mm. Hg diastolic. The heart was not enlarged and no murmurs were heard. The venous pressure was normal. An electrocardiogram showed no axis deviation.

In the abdomen was a firm, smooth, rounded swelling approximately 10 cm. in diameter. It lay in the mid-lower abdomen, but could be freely moved in all directions. It had the physical signs of a mesenteric tumour. The liver was not palpable.

The diagnosis of secreting argentaffinoma was confirmed by the finding of grossly elevated 5-hydroxy-indole acetic acid (5H.I.A.A.) levels in 24-hr. specimens of urine. These varied from 35 to 110 mg. per 24 hr. (method of Macfarlane, Dagliesh, Dutton, Lennox, Nyhus, and Smith, 1956) (*Fig.* 626). By this method the upper limit of normal is 10 mg. per 24 hr.

The hæmoglobin level in the blood was 15 g. per 100 ml. (105 per cent) and the erythrocyte sedimentation rate was 4 mm. in one hour (Wintrobe). Radiography of the chest showed no deviation from normal, and a barium-meal

examination revealed a somewhat rigid mid-gastric region (this was found at operation to be normal) and no delay in the passage of barium through the small bowel.

Laparotomy was performed under general anæsthesia. The mass was found to be a large smooth mesenteric tumour almost enveloping the superior mesenteric vessels. In the mid-ileum opposite the middle of this tumour was an inconspicuous stricture (*Fig.* 627). On the diaphragmatic aspect of the left lobe of the liver was a doubtful area of firmness, approximately 1 cm. in diameter. The mesenteric tumour was excised, leaving as much intestine as possible. In the event, marginal arteries were found to be able to supply all but 30 cm. of intestine. This was resected and continuity established by a side-to-side anastomosis. A biopsy was taken from the left lobe of the liver.

The patient's recovery was uneventful and daily estimation of 5H.I.A.A. showed an immediate and sustained fall to below 10 mg. per 24 hr. His blood-pressure remained between 120 and 140 mm. of Hg systolic and between 80 and 90 mm. Hg diastolic.

From the day after operation he experienced no more flushing attacks but his complexion retained a dusky red appearance owing to the persistence of the telangiectases. Three months after operation the complexion had returned to normal.

The specimen consisted of 30 cm. of intestine with a large tumour in the attached mesentery, together with a small wedge of liver tissue.

Histology (Dr. T. W. Sutherland) of the intestinal stricture showed acini, mainly solid, composed of tumour cells with clean-cut nuclei and finely granular cytoplasm. The bulk of the tumour lay in the submucosa and invaded the muscle coat. The mesenteric tumour showed a similar but less differentiated picture, while in the wedge of liver tissue was a small deposit of new growth composed of cells some of which contained fine faintly stained cytoplasmic granules, while others were more deeply stained. There was considerable pleomorphism. Sections were stained by the Masson-Fontana silver impregnation method and by the alkaline diazo method. The granules in the tumour cells were not stained by these methods.

DISCUSSION

The fully developed syndrome of a secreting carcinoid is seldom seen. It consists of facial flushing, diarrhœa, pellagra (due presumably to the fact that dietary tryptophane is converted to 5-hydroxy tryptamine and is not available for the synthesis of niacin), asthma, and lesions of the pulmonary or tricuspid valves of the heart, progressing to stenosis of these valves. 5-hydroxy tryptamine has been shown to be secreted by Kulschitsky cells and by argentaffinomas, and it is assumed that this substance is responsible for most of the features of the syndrome. Certainly its administration to animals and human volunteers has reproduced flushing, diarrhœa, and sometimes bronchospasm. The pathogenesis of the cardiac lesions is obscure but may be bound up with the fact that right heart blood is richer in 5-hydroxy tryptamine than left heart blood, owing to the activity of pulmonary amine oxidase (Goble, Hay, and Sandler, 1955).

5-hydroxy tryptamine is broken down by amine oxidase into 5-hydroxy-indole acetic acid. This enzyme is very widely distributed in the body, and its presence in the liver presumably accounts for the rarity of the carcinoid syndrome in association with tumours confined to the portal venous bed. 5-hydroxy-indole acetic acid is excreted in the urine, where it can be readily assayed.

In the present patient the increased urinary excretion of 5H.I.A.A. was evidence of an increased production of 5-hydroxy tryptamine. That this substance was being produced by the mesenteric node metastases and not by liver metastases was shown by the prompt return of 5H.I.A.A. urinary levels to normal, and the disappearance of the patient's flushes, following excision of the primary tumour and the mesenteric nodes. The duration of the symptoms (19 years) is interesting, but is matched by patient 3 of Snow, Lennard-Jones, Curzon, and Stacey (1955), who had flushes for 20 years.

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PROLAPSED SIGMOIDO-UMBILICAL FÆCAL FISTULA

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In an infant, umbilical fæcal fistula is usually associated with a patent omphalo-intestinal duct. The occurrence of an umbilical fistula originating in the sigmoid which closely simulated a prolapsed omphalo-intestinal duct is worthy of note.

CASE REPORT

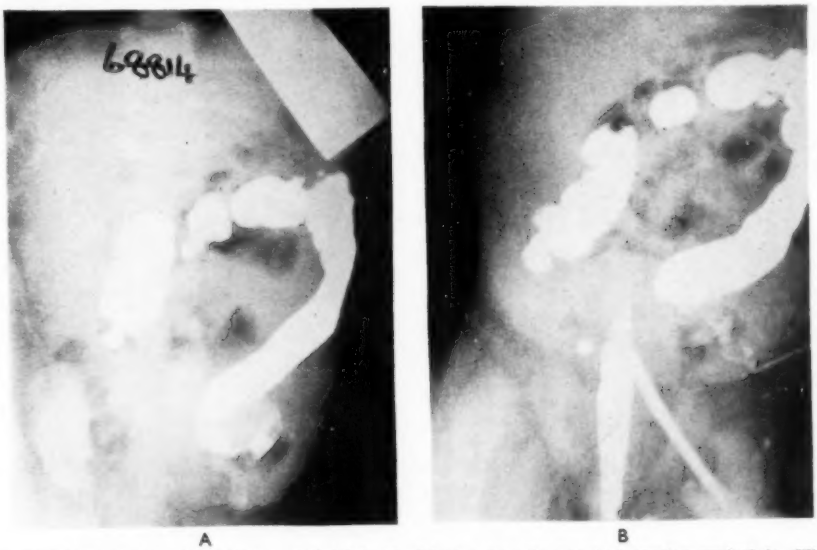
History.—V., a baby, aged 4½ months, was admitted to the Christian Medical College Hospital, Vellore, S. India, in November, 1957, with a prolapsed umbilical fæcal fistula. The parents stated that the child had looked healthy at birth and that the cord had separated normally after about one week. Following this they noticed a swelling at the umbilicus. Some 'leaves' were applied to this, as a result of which the skin over the swelling ulcerated. A fæcal discharge was first noted when the child was 1 month old. At first this was only slight, but for the past month all the fæces have been passed from the umbilicus and a red mass has appeared in this area. This mass increases in size when the child cries. The child has kept in good health since birth. There has been no diarrhœa, no vomiting, and no fever or any other sign of illness since birth.

On Examination.—Healthy infant in good general condition. Weight 12 lb. 2 oz. A red transverse tubular

mass with a narrow pedicle at the umbilicus was evident (*Fig.* 628 A). The mass was covered by a red moist membrane like intestinal mucosa and there were two openings, one at either end. A catheter could be passed deeply into both of these openings. The mass measured 3 × 1 in. Fæces were intermittently evacuated from the opening on the patient's left side. The skin immediately adjacent to the mass was scarred. Rectal examination revealed a normal sphincter and rectum containing no fæces. There was a small post-anal dimple over the sacrum in the midline between the buttocks. No other abnormality was found. Hæmoglobin, 12 g. Stool, no cysts, no ova.

A B

FIG. 628.—Pre- and post-operative photographs. A, The bicornuate nature of the prolapsed bowel and the similarity to prolapse of the omphalo-intestinal duct is apparent. B, Post-operative condition of the child and scarring in the region of the umbilicus is shown.



A B

FIG. 629.—Radiographs after injection of lipiodol. A, Injection into the left-sided opening resulted in filling of descending, transverse, and ascending colons. Note the short length of colon in this case. B, Injection into the right-sided opening resulted in filling of the rectum.

A clinical diagnosis of prolapse of the omphalo-intestinal duct with intussusception of a loop of ileum from within was shown to be wrong after X-ray examination. Lipiodol was injected into the orifices of this portion of gut. The descending, transverse, and ascending

portions of the colon were outlined from the left-hand orifice (*Fig.* 629 A). The right-sided orifice was then shown to communicate directly with the rectum and this lower segment of bowel appeared narrow (*Fig.* 629 B). The child obviously had a sigmoido-umbilical fistula, though no explanation for this was apparent.

AT OPERATION.—A transverse elliptical incision was made through the scarred skin near to the mucocutaneous junction. The abdominal cavity was entered and the loop of sigmoid mobilized. The intussuscepted loop of colon could only be reduced after incising the tight mucocutaneous ring through which the prolapse and intussusception had occurred. A catheter was passed down the distal loop and one end withdrawn from the anus. The other end was then passed up the descending colon. The defect in the colon was sutured with two layers of interrupted cotton. The abdominal wall was closed in layers transversely. Some difficulty was experienced in securing good skin apposition owing to the scarring in this area.

PROGRESS.—The child made an uneventful recovery from operation apart from the occurrence of a small area of skin separation at the centre of the wound on the fifth day. Strapping was applied over this and skin union by secondary intention soon occurred (*Fig.* 628 B). The rectal catheter was removed on the second post-operative day.

DISCUSSION

The bicornuate appearance of the prolapsed sigmoid with an opening at each end (*Fig.* 628) is typical of any prolapse of bowel through the umbilical region which is complicated by intussusception from within. A prolapsed transverse colostomy can look just like this, though occasionally it may present with two openings on the right (which represent the orifices of the appendicocæcal junction and the ileocæcal valve), as well as the single colonic opening on the left. I have seen two of these cases of bicornuate projection with three openings, in infants on whom transverse colostomy had been performed at other hospitals for rectal atresia. A prolapse of ileum through a wide omphalo-intestinal duct can also look like this, or it may take on a T shape. This was well illustrated by Barrington-Ward (1928), and there have been numerous descriptions of this anomaly in recent years (Kittle, Jenkins, and Dragstedt, 1947; Moore and Schumacker, 1952; Milroy Paul, 1953; Ravitch, 1957; Johnston, 1957; Souttar, Douglas, and Dennison, 1958). As far as I have been able to ascertain this is the first case to be reported in which the sigmoid has been implicated in this type of prolapse without previous operative procedures.

The well-being of this child and the insidious onset of the fistula suggest a congenital cause for this anomaly. It is possible that during fœtal life a mild meconium peritonitis resulted in incarceration and adherence of a portion of the colon wall in the physiological umbilical hernia. After birth the slow unremitting compression of the contracting skin scar resulted in strangulation of this part of the colon and also devascularization and thinning of the overlying skin. The 'leaves' that were applied hastened ulceration and a fæcal fistula then ensued. This process of devascularization of overlying skin by contraction of a skin scar at the neck of an interstitial hernial loculus has been described in the adult by O'Donoghue (1955) and the same process may occur in the infant. The umbilical cicatrix is a very dense, though physiological, scar. Reaction of the skin and underlying tissues, at their junction with Wharton's jelly, to the necrosis of the base of the umbilical cord probably accounts for this almost universal cicatrix. This skin scarring is especially dense in babies who have umbilical cords with a broad base or who are born with a very minor or partial type of exomphalos which heals spontaneously. If a small knuckle of bowel was retained by adhesions in such a partially amnion-covered umbilical hernia, contraction of the dense umbilical skin cicatrix could lead to a fistula in this manner.

Strangulation of gut in an umbilical hernia has been reported at birth, and Barrington-Ward (1928) has suggested that antenatal strangulation or incarceration of the small intestine may also occur. Several cases are on record where an umbilical hernia has contained portions of intestine entirely cut off from, and with corresponding defects in, the bowel. If this occurs the child may be born with the remnants of an omphalocoele sac and a double-barrelled ileostomy (Barrington-Ward, 1928; Nixon, 1955). Variations of this anomaly include a case born with a blind loop of colon in an exomphalos with an intra-abdominal atresia of the transverse colon (Nixon, 1958), and an infant with an umbilical biliary fistula which communicated directly with the gall-bladder (Waterston, 1958). Presumably, in the latter case the fundus of the gall-bladder was strangulated in the physiological umbilical hernia duirng fœtal life. Similarly retention and later strangulation of a portion of the colon wall may have resulted in the fæcal fistula that has been described above.

There are other possible causes, and these can be briefly considered and dismissed: (1) Abnormal omphalo-intestinal duct with attachment to sigmoid. Although many variations of the attachments of this duct have been described, including an attachment to the appendix (Crymble, 1921), it is highly unlikely that this structure would arise from or gain secondary attachments to the hind gut. (2) Trauma to the base of the cord by a proximally placed ligature would have given rise to a fistula within a few days of birth, and there would have been more systemic upset than found in this case. (3) Richter's hernia of a portion of the bowel wall followed by ulceration of the overlying skin and formation of a fæcal fistula is a highly unlikely post-natal event in an infant, although spontaneous prolapse of bowel onto the abdominal wall through a strangulated incisional hernia due to diasppearance of the overlying skin has been recorded in an adult (O'Donoghue, 1955).

SUMMARY

A case is reported of sigmoido-umbilical fæcal fistula with prolapse and intussusception of sigmoid from within. A review of the literature has failed to reveal a similar type of case. The cause is considered to be congenital and related to fœtal incarceration of a knuckle of gut wall in the physiological umbilical hernia and post-natal strangulation by contraction of the umbilical cicatrix.

I would like to thank Mr. D. J. Waterston and Mr. H. H. Nixon for much help and advice in the preparation of this paper.

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MYOSITIS OSSIFICANS IN THE REGION OF THE HIP-JOINT

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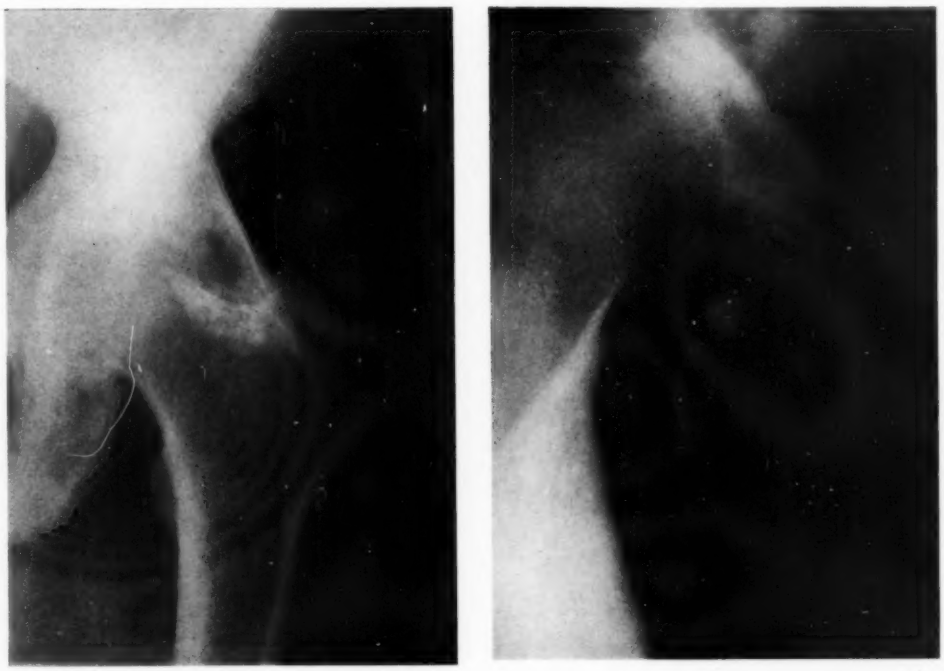
MYOSITIS ossificans in the region of the hip-joint is known to occur in a variety of conditions. In paraplegics there seems to be a predisposition to the laying down of bone (Miller and O'Neill, 1949; McNeur, 1954).

Freiberg (1952) reported periarticular ossification around the hip following acute anterior poliomyelitis.

Perhaps the most common cause of myositis ossificans in this area is trauma, yet Armstrong (1948), in a review of 101 traumatic dislocations of the hip-joint, encountered 1 case only, and Stewart and Milford (1954) were surprised to find that of 90 patients with fracture-dislocations of the hip treated by manipulation only 2 developed myositis ossificans.



A B

FIG. 630.—Anteroposterior and lateral views of the hip, showing the ossification running in the line of the rectus femoris muscle.

Two cases are reported here because of the similarity of their radiographs. In *Case* 1 there was a history of injury. *Case* 2 presented no definite evidence of trauma, but an opportunity for necropsy examination was possible.

FIG. 631.—The right hip-joint with the bridge of bone extending from the anterior inferior iliac spine downwards in the rectus femoris muscle.

CASE REPORTS

Case 1.—A heavily built male, aged 48 years, was running for a 'bus when he felt a sharp stab of pain in the left thigh, which radiated to the knee. The pain was severe enough to slow him up and he had to reduce his speed to walking pace. He worked the next day, but with difficulty, and bruising developed over the thigh. For several days after this event he had to support his left thigh into his car owing to a feeling of weakness. Some months later he noticed a lump in the thigh and was referred to the Orthopædic Department.

Examination showed an ill-defined swelling just below the anterior superior iliac spine, approximately 5·0 by 2·5 cm. wide. It was hard and fixed, but not tender. The range of flexion at the hip-joint was slightly reduced, other movements being normal.

Radiographs revealed the appearance shown in *Fig.* 630.

Case 2.—A man, aged 68 years, was first seen because of pain in the right shoulder. Recently he had had pain in the left side of the chest. Clinical and radiographic examination established the diagnosis of carcinoma of the right bronchus with secondary deposits in the outer side of the right clavicle. He had complained of left sciatic pain and, in the course of routine investigations, radiographs of the pelvis and hip-joints showed the appearance seen in *Fig.* 631.

There was a normal range of hip movements and the patient could not remember any recent injury to the joint. He died shortly after admission and a post-mortem examination gave an opportunity to investigate the right hip in greater detail.

NECROPSY REPORT.—

External Appearance: Thin male, 68 years old, with marked œdema of left upper extremity.

FIG. 632.—Photograph of specimen removed at post-mortem.

FIG. 633.—Radiograph of specimen shown in *Fig.* 632.

Thoracic Cavity: Left pleural effusion. Neoplastic deposits in left lung and peribronchial lymphatic chain. Enlarged glands compressing the superior vena cava. Secondary neoplastic deposits in the outer end of the left clavicle, ribs, and sternum.

Abdominal Cavity: Gastro-intestinal tract, nothing abnormal. Neoplastic deposits in mesenteric glands, both adrenals, and liver. Small neoplastic seedlings in kidneys and spleen.

Right Hip: An apparent bony diamond-shaped structure was bridging the hip. It was deeply embedded in the fibres of the reflected head of rectus femoris muscle.

Naked-eye Examination of Mass: Irregular diamond-shaped mass of tissue measuring 9 × 3 cm. in greater diameter. The mass consists of a portion of the body of ilium and articulating with it is a bony hard structure terminating distally in a fibromuscular 'rat tail' (*Fig.* 632). Radiograph of the specimen, *Fig.* 633.

Histological Examination of Mass: Reveals an irregular portion of bone in a fibrous stroma containing marrow. In marrow spaces there is a diffuse infiltration by malignant cells of oat-cell type. The 'rat tail' portion reveals an irregular portion of osteoid tissue surrounded by fibrous tissue and fragments of skeletal muscle. No evidence of tumour.

Histological Examination of Specimens removed at Necropsy: Reveals an undifferentiated carcinoma of the lung of oat-cell type, with secondary deposits in liver, kidney, spleen, and adrenals and pelvis.

DISCUSSION

The remarkable similarity in appearances of these two hips seen within a short time of one another aroused one's interest in the site of ossification. The first case was clearly related to injury. In the second case there had been no immediate history of injury, but the patient had been a ship's engineer all his working life and stated that he had been subject to many falls. In a search through the literature for cases of a similar appearance, only 1 was discovered Kohler (1956), and this was attributed to an exostosis of the inferior iliac spine. Doubt, however, was expressed by the author as to the real nature of the bony prominence, whether it was an ossifying myositis or a calcified insertion of a tendon, or an exostosis proper.

The post-mortem examination in *Case* 2 showed that the condition was not due to an exostosis of the anterior inferior iliac spine. The ossification was within the rectus femoris muscle and proximally a small false joint was present. This would indicate that ossification had occurred after rupture of the origin of the rectus femoris, subsequent movements leading to a pseudarthrosis. By analogy it was felt that a similar condition prevailed in *Case* 1.

Proximal rupture of rectus femoris is an uncommon injury, Platt (1931) and McMaster (1933) reporting no cases in their review of muscle-tendon ruptures. Steiner (1951) recorded a case of traumatic ossification in the proximal portion of the rectus femoris, but the site of ossification was speculative and the radiographic appearances would suggest another location in view of the evidence gained in *Case* 2.

Weitzner (1935) reported a case of fracture of the anterior inferior iliac spine with subsequent ossification. The radiographic appearance did not resemble those recorded here.

In *Case* 1, I believe the nature of the injury to have been a tear of the rectus femoris muscle from the acetabular margin, with subsequent traumatic subperiosteal ossification Without any specific history of injury to the right hip-joint in *Case* 2, one can only hazard the suggestion that the sequence of events was of a similar nature.

I wish to thank Dr. E. Wilder, formerly Assistant Pathologist, Hartlepools Hospital Management Committee, for his help in the pathological investigation of *Case* 2; and Mr. A. Webb-Jones, for his permission to quote *Case* 1.

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AN ABNORMALITY OF THE PANCREAS, WITH DIVERTICULA OF THE DUODENUM AND JEJUNUM

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In a male subject, aged 67 years, with four diverticula of the duodenum and one of the jejunum, dissection revealed that the duodenum was constricted by an abnormal main pancreatic duct and that a subsidiary duct opened into the largest of the diverticula. The cause of death was certified as congestive cardiac failure and the only clinical information obtainable was that "for some time" the patient had suffered from dyspepsia and vomiting.

THE SPECIMEN

The main pancreatic duct (*Fig.* 634, **12**) passed horizontally through the body and head of the pancreas. It did not descend towards the ampulla of Vater, but crossed the anterior aspect of the duodenum, concealed in an inconspicuous band of pancreatic tissue. Passing through the lateral wall, it opened on the posterolateral aspect of the duodenum, which was at this level constricted to an internal diameter of 9 mm. The second

part of the duodenum was dilated both proximal and, to a lesser extent, distal to the constriction. The ducts throughout the pancreas were slightly dilated. From the posterior aspect of the main pancreatic duct an accessory duct passed through the pancreatic tissue, to open in diverticulum **1** through a very narrow orifice (**11**) on a thickening of the vertical septum (**10**).

The common bile-duct was 9 mm. in diameter and opened onto the posterior wall (**7**) of the duodenum,

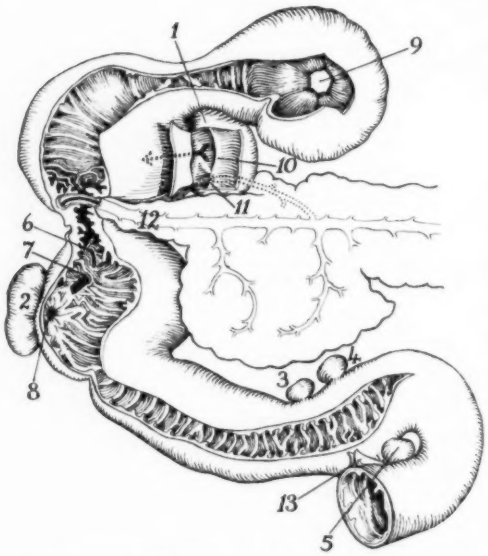

FIG. 634.—Duodenum, opened along anterior surface, and pancreas with ducts dissected. **1**, Diverticulum with anterior wall reflected; **2–5**, Diverticula; **6**, Probe in orifice of main pancreatic duct; **7**, Probe in orifice of common bile-duct; **8**, Opening of diverticulum **2**; **9**, Pylorus; **10**, Vertical septum in diverticulum **1**; **11**, Orifice of accessory pancreatic duct on summit of septum; **12**, Main pancreatic duct (opened to show probe) crossing anterior aspect of duodenum; **13**, Mesentery.

11 mm. inferior to the opening of the main pancreatic duct. The mucosa around both orifices was raised into numerous irregular folds. No pancreatic duct could be detected joining the bile-duct at or near its orifice.

Diverticulum **1**, the largest, had a wide opening (26 × 22 mm.) into the medial wall of the second part of the duodenum. It was superior and posterior to the pancreas and adherent to it. It was 40 mm. deep, 44 mm. long, and 42 mm. wide. The septum (**10**) on which the accessory pancreatic duct opened had a maximum height of 15 mm., was thicker than the wall of the diverticulum, and stretched from the inferior margin of the opening, vertically upwards in the coronal plane, to join the superior margin. It therefore partly divided the diverticulum into anterior and posterior parts. Diverticulum **2** was on the lateral, convex margin of the second part of the duodenum, near its junction with the third part. It had a narrow opening (**8**), 6 mm. in diameter, and was 18 mm. deep, 31 mm. long, and 23 mm. wide. The third diverticulum (**3**) was on the concave, superior border of the end of the third part of the duodenum, and the fourth (**4**) was similarly placed on the beginning of the fourth part. Their openings were 4 mm. in diameter. The third was 12 mm. deep, 14 mm. long, and 9 mm. wide, and an artery with its vena comitans entered its wall near the apex. The fourth was 14 mm. deep, 17 mm. long, and 10 mm. wide. An artery with its vena comitans entered the anterior wall near its junction with the duodenum. The jejunal diverticulum (**5**) was at the mesenteric attachment (**13**), 10 cm. from the duodenojejunal junction. Its opening was 7 mm. in diameter and it was 14 mm. deep, 16 mm. long, and 12 mm. wide. There were no other diverticula in the digestive tract or in the bladder.

HISTOLOGY.—Section of the anterior wall of the duodenum, in the region of the constriction, showed that pancreatic tissue was present in the adventitia as far as the entry of the pancreatic duct into the duodenal wall. There was no pancreatic tissue on the posterior aspect of the duodenum. The walls of diverticula **1** and **2** consisted of mucosa with villi, a normal muscularis mucosæ, and a thin layer of smooth muscle. No Brunner's glands or pancreatic tissue were found in the parts sectioned.

DISCUSSION

The duodenum is second only to the colon as the most frequent site of intestinal diverticula. Duodenal diverticula have been fully described by Odgers (1930) and Edwards (1935), the clinical picture by Waugh and Johnston (1955), the complications by Ogilvie (1941), and the X-ray appearances by Case (1920). Jejunal diverticula are less common than duodenal and there has been less controversy about their aetiology. Rosedale and Lawrence (1936) give an incidence of 1·3 per cent at autopsy and at radiography the incidence is usually much less. They have been described by Edwards (1936) and Orr and Russell (1951), and their complications by Milnes Walker (1945). The diverticula are considered to be herniations of the mucosa, submucosa, and a varying amount of muscularis through the bowel wall due to increased intra-intestinal pressure caused by a disorder of peristalsis. This herniation can occur at any area of weakened muscularis—in the jejunum, almost always the point of entry of a blood-vessel at either side of the mesenteric attachment. In the case of duodenal diverticula, too, this theory is now more generally accepted than the theory of congenital origin, which was mainly based on the facts that outpouchings of mucosa do occur in the embryo throughout the duodenum; that diverticula have been found, though rarely, in infants; that diverticula may have accessory pancreatic tissue in their walls; and that they may be associated with diverticula in other organs. True congenital diverticula do occur. They are present at birth and possess all the layers of normal bowel wall, like a Meckel's diverticulum. The usual duodenal diverticula are much commoner in people over 50 years of age and rarely have more than a single layer of stretched muscularis in their walls. The greater frequency of diverticula in the duodenum is considered to be due, not to its more numerous embryological events, but to the fact that a closed pylorus facilitates a rise in intraduodenal pressure and the entry of the pancreatic and bile-ducts into the duodenum provides additional points of weakness through which, in later life, herniation may occur. The specimen described is of interest because the largest diverticulum has arisen between the pylorus and the constriction where the highest intraduodenal pressure could be expected to occur, and because diverticulum **2** is on the convex border of the duodenum—an uncommon situation.

Estimations of the frequency of duodenal diverticula depend on the method used to detect them.

Radiography shows an incidence of 1·2 per cent (Case, 1920) and 3·8 per cent (Spriggs and Marxer, 1925). The highest figure—22 per cent—is given by Ackermann (1943) from examination of dissecting-room subjects. Examination of the duodenum in each of the 13 subjects at present in the dissecting room of this department showed that 6 (including the present specimen) had diverticula, an incidence of 46 per cent. All were on the concave border of the duodenum.

I have been unable to find a record of a similar abnormality of the pancreatic ducts. The condition of annular or ring pancreas has been fully described by McNaught (1933), Tendler and Ciuti (1955), and Mast, Telle, and Turek (1957); but in all except one of the cases in which they have been dissected out, the ducts of the head and body of the pancreas have shown no gross abnormality. The ring of pancreatic tissue is drained either by a duct passing anteroposteriorly around the lateral aspect of the duodenum to the ampulla of Vater or to the main pancreatic duct; or by small tributaries passing medially to join the ducts of the head, anterior and posterior to the duodenum. In the latter case the annular pancreas is assumed to be due to hypertrophy of the head of the pancreas enveloping the duodenum. In the former case it has been ascribed to persistence of the left ventral pancreatic bud as well as the right, or to an abnormal fixation of the right bud so that, when the ventral pancreas and common bile-duct assume their adult position on the dorsal (medial) aspect of the duodenum, a ring of pancreatic tissue is left extending around the ventral aspect, with its apex fused, in front of the duodenum, with the head of the pancreas. In a case described by Anderson (1923) the main pancreatic duct drained only the lower part of the head, passed around the duodenum in the annular pancreatic tissue, and joined the common bile-duct at the ampulla of Vater. The accessory pancreatic duct had no connexion with it and drained the body and upper part of the head of the pancreas.

In the present specimen the dorsal pancreas seems to have developed at the normal situation, diverticulum 1 having developed at this site. The ventral pancreas has developed at a separate site from the common bile-duct, or may have been separated from it during development. The interpretation of any abnormality of the pancreas on the basis of the normal number and disposition of the pancreatic buds is open to criticism, since the incidence of accessory pancreatic tissue and the recorded variations of the pancreatic ducts indicate that the ability of the embryonic duodenum to form pancreatic buds is by no means strictly localized. However, the absence of pancreatic tissue from the posterior aspect of the duodenum in this case suggests that the abnormality may be due to persistence of the left ventral pancreatic bud instead of the right.

The surgical importance of these findings is that annular pancreas can cause intestinal obstruction, either in the neonatal period, or in later life when chronic pancreatitis, to which the annular pancreatic tissue is said to be predisposed, may be the cause of narrowing of the constricting ring. The possibility that a strip of pancreatic tissue—inconspicuous until dissected in this case—across the front of the duodenum may contain the main pancreatic duct, makes incision of the stenosed portion of the duodenum potentially hazardous and suggests that duodeno-enterostomy is preferable. Only a small proportion of duodenal diverticula require surgical intervention, but the fact that the accessory pancreatic duct may open into a diverticulum in the region of the minor papilla is an additional danger, particularly since it has been stated that in 10 per cent of cases the accessory duct alone drains the pancreatic secretions (Millbourn, 1949; Kleitsch, 1955).

SUMMARY

1. An anatomical specimen showing one jejunal and four duodenal diverticula with an abnormal main pancreatic duct constricting the duodenum is described. This specimen is displayed in the museum of the Anatomy Department.

2. The surgical significance of the findings is discussed.

I wish to thank Professor Lockhart for his help and encouragement in the preparation of this paper.

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REVIEWS AND NOTICES OF BOOKS

Cancer. Edited by RONALD W. RAVEN, O.B.E.(Mil.), T.D., F.R.C.S., Joint Lecturer in Surgery, Westminster Medical School, University of London; Surgeon, Westminster Hospital Teaching Group. Volume 5. Part ix: Radiotherapy. 9½ × 6½ in. Pp. 406 + viii, with 136 illustrations. 1959. London: Butterworth & Co. (Publishers) Ltd. 85s.

THE latest volume in this series covers Radiotherapy. The early chapters give a good account of the theory of the production and effect of ionizing radiations, despite the fact that Planck's constant is given two different values within twenty pages and both of them incorrect. The biological consequences of subjecting humans to these radiations are well discussed from the point of view of chromosome damage and the effect on the stroma or tumour bed. Little is said about the effect on the genes themselves, other than is implied in chromosome breakages, and this is a serious omission in view of the close relation of carcinogens and mutagens and the importance of ionizing radiations in the former role.

Dosage and protection problems are adequately covered and the later chapters, following the convention of previous volumes, are devoted to a discussion of different regions. The latest number, unlike certain of the previous volumes, serves a well-defined purpose. It gives in a clear and readily understood form all that the general surgeon or worker in cancer problems, who is not specifically engaged in radiobiology or its applications, requires to know.

Diseases of the Colon and Anorectum. Edited by ROBERT TURELL, M.D., Associate Surgeon and Chief, Rectal Clinic, The Mount Sinai and Montefiore Hospitals. 10 × 6½ in. In two volumes: Volume I, Pp. 1–608 + xxii, with 351 illustrations; Volume II, Pp. 609–1238 + x, with 283 illustrations. Fully indexed. 1959. Philadelphia and London: W. B. Saunders Co. £12 5s.

THIS large and exhaustive two-volume work covers every aspect of colonic and rectal diseases. There are some eighty-four contributors, all of whom are concerned in the treatment of conditions and tumours of the colon and anorectal region. If any criticism could be levelled at this work it would be that too many different operative techniques are given for any one condition.

The pictures which illustrate these two volumes are quite good on the whole, but some might be of a better standard. Professor J. C. Goligher contributes an excellent chapter on the surgical anatomy of the colon, rectum, and anal canal. Never before have so many contributors been engaged in such a comprehensive effort.

These volumes will remain the reference work on colonic and rectal diseases for some time to come.

Vascular Surgery. By GEZA DE TAKATS, M.D., M.S., F.A.C.S., Clinical Professor of Surgery, University of Illinois. 9¾ × 6½ in. Pp. 726 + x, with 382 illustrations. 1959. Philadelphia and London: W. B. Saunders Co. £6 2s. 6d.

DURING the last decade vascular surgery has come into its own and has almost become a surgical specialty. This large volume covers every feature of vascular surgery, every operative technique that is or has been in vogue with American surgeons. All the vascular syndromes are well described and the appropriate treatment is outlined.

The many and varied surgical procedures are portrayed and the line drawings depicting arterial exposure are excellent. The various by-pass procedures, the excision and grafting for aneurysms, and embolectomy are described in a very practical and lucid style.

The author still believes in sympathectomies for certain cases and the different operative procedures are described in detail.

A useful reference volume which gives an up-to-date account of vascular surgery.

The Management of Fractures and Dislocations—An Atlas. By ANTHONY F. DE PALMA, M.D., Professor of Orthopedic Surgery, Jefferson Medical College. 12½ × 9 in. In two volumes: Volume I, Pp. 1–470, Volume II, Pp. 471–960, with 1927 illustrations. Fully indexed. 1959. Philadelphia and London: W. B. Saunders Co. £12 5s.

THIS large two-volume atlas contains nearly two thousand line drawings depicting every type and kind of fracture and dislocation which the human frame is subject to. Other joint injuries are also included. The reader is presented with an atlas of easy reference in which the essential characteristics of the various lesions are readily recognized and the detailed methods of reduction, immobilization, and post-reduction management are clearly visualized.

As a work of reference these two volumes could not be bettered, and they should be of value not only to students but also to practitioners and nurses.

Anatomy for Surgeons. Volume 3, *The Back and Limbs.* By W. HENRY HOLLINSHEAD, Ph.D., Professor of Anatomy, Mayo Foundation, University of Minnesota. 10¼ × 7 in. Pp. 901 + xii, with 785 illustrations. 1959. London: Cassell & Co. £8 8s.

THE third volume of this interesting work on anatomy for surgeons is devoted to the regional anatomy of the back and limbs. There can be little doubt that this third volume will prove as popular as the two previous volumes, for it gives the modern surgeon what he has been looking for over the years.

The book is well illustrated with some 785 pictures, some of which are original, while others have been copied from various journals.

There can be little doubt that the three volumes which go to make up this work will prove of real value to the busy surgeon who wants to refresh his memory on any particular region of the body. It meets a very real need and will be popular.

Röntgendiagnostik des Chirurgen. By OTTO KINGREEN. Fourth edition. 9½ × 6½ in. Pp. 410 + viii, with 766 illustrations. 1958. Leipzig: J. A. Barth. Bound, D.M. 32; unbound, D.M. 30.

SOME recent spectacular advances in surgery owe much to developments in the realm of diagnostic radiology. Thus, modern vascular surgery would be inconceivable without angiography.

This particular 'success-story' may be said to highlight a partnership of considerable standing, which has been of inestimable value to the surgeon. A book such as this one is overdue, and therefore sets out with everything in its favour.

In order to present a complete picture, which its title stipulates, this work must inevitably duplicate portions of surgical and orthopædic texts, and overlap the confines of surgery into thoracic medicine and gastro-enterology. Unfortunately, there is here an excess of duplication,

almost amounting to padding—more than half the book is devoted to an illustrated catalogue of bone and joint injuries and affections. It is disappointing to find that the account is, in fact, far from complete; apart from omissions, many techniques receive scant or inadequate treatment.

The omissions first: it is to be hoped that few surgeons will need reminding of the radiological signs of costal erosion in coarctation of the aorta, and of a prominent gastric air-bubble in infants with œsophageal atresia and tracheo-œsophageal fistula formation. However, one cannot justify failure to mention the radiological role of the cardiac catheter, the entire range of gynæcological techniques—to mention only salpingography in tubal plastic surgery for infertility—and presacral pneumography, of use in the diagnosis of adrenal and other retroperitoneal tumours.

Insufficient consideration is given to angiography in particular. The whole subject of peripheral vascular disease, which has made such strides under its impact, is very sketchily dealt with on one page. Aortography, about which a monograph was recently published, is mentioned chiefly to stress its dangers. Portal venography also gets short shrift—the direct technique at the time of operation might have been mentioned.

Arthrography is only considered in relation to the knee; its use in congenital dislocation of the hip is not discussed.

The bibliography is extremely limited, and is largely based on material from one German radiological journal. The illustrations, of special importance in a radiological treatise, are patchy in quality.

This book does not come up to the standard set by recent German publications.

Breast Cancer. The Second Biennial Louisiana Cancer Conference. Edited by ALBERT SEGALOFF, M.D., Director of Endocrine Research, Alton Ochsner Medical Foundation. $9\frac{3}{4} \times 6\frac{1}{2}$ in. Pp. 257, with 43 illustrations. 1958. St. Louis: C. V. Mosby Company. (London: Henry Kimpton.) 37s. 6d.

THIS monograph consists of a series of articles which were submitted at the Second Biennial Louisiana Cancer Conference which met under the aegis of the American Cancer Society. The various chapters cover all the important facets of the cancer problem relating to the breast.

Although the extended radical operation for carcinoma of the breast, in which the lymphatics of the mediastinal area are dissected, is advocated, one cannot see that there is any statistical evidence that this mutilating operation gives any better results than the ordinary radical mastectomy. However, time will eventually give us the answer. Cancer of the breast is certainly a unique form of malignancy in many ways.

Modern Trends in Diseases of the Vertebral Column. Edited by REGINALD NASSIM, B.M., F.R.C.P., Physician to St. George's Hospital and the Royal National Orthopædic Hospital, London; and H. JACKSON BURROWS, M.D., F.R.C.S., F.R.A.C.S., Orthopædic Surgeon, St. Bartholomew's Hospital, London. $9\frac{7}{8} \times 6\frac{1}{2}$ in. Pp. 292 + x, with 172 illustrations. 1959. London: Butterworth & Co. (Publishers) Ltd. 75s.

THIS is a very useful book, edited by a general physician and an orthopædic surgeon; these editors have wisely collected a band of contributors covering every aspect of diseases of the spine. One is so pleased to see that the book is written on an anatomical basis, which is important these days.

Diseases of the spine are many and very varied and include many degenerative conditions. Spinal cord injuries and displaced disks have come to the fore since the end of the second world war. This book highlights the field of advancing knowledge in which primary disease may either cause a spinal condition directly or affect the spine indirectly.

The illustrations in this book have been well chosen, especially the radiographs, which are excellent.

This monograph will appeal to a large section of the medical community, not the least those doctors who are sitting on appeal boards for the Ministry of Pensions and who have to deal with so many cases of back and sprain injury.

Staphylococcal Infections. By IAN MACLEAN SMITH, M.D., Ch.B., F.R.F.P.S.G., Assistant Professor and Chief, Infectious Disease Division, Department of Internal Medicine, State University of Iowa. $7\frac{3}{4} \times 5\frac{1}{4}$ in. Pp. 180. 1958. Chicago: The Year Book Publishers Inc. (London: Interscience Publishers Ltd.). 32s.

THIS is a useful little monograph which deals with the all too frequent condition of staphylococcal infection, especially due to the resistant strains.

It is quite true that staphylococcal diseases have always been important to the doctor. Before the discovery of the sulphonamides and penicillin many attempts were made to stop chronic disease or to bring about localization of acute spreading infection. Many and varied were the treatments advocated, from bacteriophage to autogenous blood injections, but patients quite often died.

Dr. Maclean Smith has written a very useful book pointing out the rational treatment of staphylococcal infections and the part played by antibiotics and penicillin in this treatment.

Re-education of the Injured Shoulder. By R. BARRIE BROOKES, F.C.S.P., Rehabilitation Officer, Birmingham Accident Hospital. $8\frac{1}{2} \times 5\frac{1}{2}$ in. Pp. 114 + viii, with 59 illustrations. 1959. Edinburgh and London: E. & S. Livingstone Ltd. 12s. 6d.

MR. BROOKES is a physiotherapist with a deep interest in the shoulder, and considerable experience in its treatment. He starts his book with a clear account of the anatomy and pathology; but it is the later chapters that are most helpful, because they contain many of his own clinical observations and views on treatment. Anyone interested in the treatment of shoulder injuries would be well advised to read this book.

British Surgical Practice. Surgical Progress 1958. Edited by Sir ERNEST ROCK CARLING, LL.D., F.R.C.S., F.F.R., Honorary Consulting Surgeon, Westminster Hospital; and Sir JAMES PATERSON ROSS, K.C.V.O., LL.D., M.S., P.R.C.S., F.R.A.C.S., F.A.C.S., Surgeon and Director of Surgical Clinical Unit, St. Bartholomew's Hospital, London. $9\frac{3}{4} \times 6\frac{1}{2}$ in. Pp. 441 + x, with 98 illustrations and fully indexed. 1958. London: Butterworth & Co. (Publishers) Ltd. 52s. 6d.

THIS volume contains some excellent articles dealing with surgical conditions and diseases in which surgical progress has been achieved. There are two good original articles, one on collagen diseases and the other on venous ulcers of the leg.

There are numerous critical reviews by surgeons, both at home and overseas; these reviews are of a high standard and give an admirable account of the present treatment in vogue for conditions such as Crohn's disease, ulcerative colitis, acute head injuries, glaucoma, and various syndromes.

As an up-to-date book of reference this volume of surgical progress could not be bettered. It should prove of real value not only to the surgeon but to all those postgraduate students who are attempting higher surgical degrees or diplomas.

Brain, Memory, Learning. By W. RITCHIE RUSSELL, C.B.E., M.D. (Edin.), D.Sc. (Oxon.), F.R.C.P. (Edin. and Lond.), Lecturer in Neurology, University of Oxford. 8½ × 5½ in. Pp. 140 + xii, with 12 illustrations. 1959. Oxford: Clarendon Press. 18s.

No two people think of the brain in the same way, the author tells us, and this small book, which is to some extent speculative, cannot be regarded as representing the view of neurologists in general. There is little, however, with which most who read it will want to quarrel. The central theme is the probable importance of tonic neuronal activity, coupled with the altered conditions of intercellular transmission to which it may give rise, but particular consideration is given to clinical problems such as the traumatic amnesias, focal fits which cause hallucinations, and phantom limbs. A bias in favour of the localized specialization of particular areas of the brain is detectable. We are told that prefrontal leucotomy may reduce dreaming in psychotic patients and injury in the parieto-occipital region may abolish it altogether; nevertheless the author holds that there is over-riding control from the frontal lobes of all parts of the brain and supports a mass action effect of neurons; the "super ego tends to win, because its army of nerve cells is largest". His claim that he introduced repeated percussion as a method of abolishing painful amputation stumps in 1949 overlooks similar work by Hugh Carlton, of Bristol, after the first world war, but this is perhaps only another instance, so often seen in the history of medicine, that rediscoveries are continually being made by those who are working along similar lines. As a summary of the views of a distinguished neurologist the book should have a wide appeal. Its clarity of expression in large clear type makes easy reading. There is a list of references and an index.

Illustrated Pre-operative and Post-operative Care. By PHILIP THOREK, M.D., F.A.C.S., F.I.C.S., Professor of Surgery, Cook County Graduate School of Medicine. 9 × 6 in. Pp. 98 + xii, with 60 illustrations. 1959. London: Pitman Medical Publishing Co. Ltd. 30s.

THIS is a useful little illustrated monograph which can easily be carried in the student's pocket for ready reference. It contains useful information and stresses the importance of water balance, diet, acidosis, and alkalosis. The cost is very moderate and the modern medical student will find this book both helpful and practical.

Autopsy Diagnosis and Technic. By OTTO SAPHIR, M.D., Clinical Professor of Pathology, University of Illinois Medical School, Chicago. Fourth edition. 7½ × 5 in. Pp. 549 + xxiv, with 80 illustrations. 1958. London: Cassell & Co. 63s.

THIS small book is a working guide to the recognition of disease by gross changes in structure. For the most part the author deals with post-mortem appearances and a vast amount of useful information, covering a wide field, is expressed in concise language. Its British counterparts were a book of similar size written by Box and now out of print, and the popular but even smaller manual by Joan Ross.

Pathological histology is not dealt with and the book is not intended to rival a text-book of pathology. Nevertheless, it provides a sound guide to naked-eye pathology and will certainly be of assistance to young pathologists and possibly, but in a more limited way, to the young surgeon.

Bleeding Esophageal Varices—Portal Hypertension. By HIRSCH ROBERT LIEBOWITZ, B.S., M.D., Assistant Professor of Clinical Medicine, New York University College of Medicine. Section on Surgical Treatment in collaboration with LOUIS M. ROUSSELOT, M.D., M.S.(Surg.), Med.Sc.D.(Surg.), F.A.C.S., Director of Surgery, St. Vincent's Hospital, New York. 9¾ × 6½ in. Pp. 986 + xxxiii, with 178 illustrations. 1959. Springfield, Illinois: Charles C. Thomas (Oxford: Blackwell Scientific Publications). £9 3s. 6d.

THIS large volume covers the whole field of portal hypertension and enlarged œsophageal varices. It is not commonly understood that hæmorrhage from œsophageal varices is the most frequent cause of death from upper gastro-intestinal bleeding, having displaced that arising from peptic ulcer. Moreover it is the most common factor in initiating hepatic failure and coma.

Louis M. Rousselot has written an excellent account of the surgical management of portal hypertension; this includes a concise description of the various surgical techniques.

Throughout the book excellent illustrations enhance the value of the text. Some of the radiographs depicting enormous œsophageal varices are truly remarkable; one has never seen such huge venous channels before.

Professor Allen O. Whipple writes a foreword to this book and is high in his praise of the whole production.

As a reference volume on this subject the book could not be bettered.

Third Tissue Homotransplantation Conference. Edited by BLAIR O. ROGERS. 9 × 6 in. Pp. 359, fully illustrated. 1958. New York: New York Academy of Sciences. $5.00.

THIS monograph, comprising some 300 pages, contains thirty-seven papers read at the third Tissue Homotransplantation Conference held in New York in 1958. The nationality of the contributors is predominantly, but not inordinately, American; and valuable contributions have been made from Czechoslovakia, Denmark, France, and Great Britain.

The papers are grouped into four sections. The first deals with embryonal, fœtal, neonatal, and infant tissue transplantation, the second with the immunogenetics of tissue transplantation, the third with antibodies and antigens, and the final section is concerned with the graft-host reactions and acquired tolerance.

Many of the papers are too highly technical to appeal to the surgeon or cancer-research worker who has not been specially trained in this field, but there are a number of articles which epitomize current knowledge and are of the greatest value to the outsider who would wish to keep up-to-date. The discriminating reader can soon pick out those parts which appear to have a more discursive flavour, and these can be consumed even by the uninstructed with relish. For the expert—and no doubt there are very few experts who are not contributors and who will therefore automatically possess a copy—this monograph is an essential work of reference.

Certain contributions deserve special mention. In the discussion following Southam and Moore's excellent paper on Induced Immunity to Cancer Cells, James Grace, of Buffalo, N.Y., has some extremely pertinent comments to make on the subject of host tolerance to cancer cells. These observations are based on some interesting experiments of simultaneous grafting of cancer cells and skin to a homologous host. The hosts were volunteer patients in the terminal stages of malignant disease. Both grafts were rejected approximately simultaneously. Nevertheless the

skin persisted somewhat longer than is normally the case, suggesting that there was some depression of homograft defences in these patients.

From English workers there are excellent papers by L. Brent, working with J. H. Berrian, on Cell-bound Antibodies in Transplantation Immunity, and P. A. Gorer contributes the usual lucid account of his work on H-2 Antibodies *in vivo* and *in vitro*.

For the surgeon perhaps the most interesting section is that on Acquired Tolerance, for herein lies the solution to the problem of homologous skin-grafting. This is a very full section and deals with all aspects of acquired tolerance, particularly that acquired by lethal doses of X-irradiation. If no answer is forthcoming, at best this part of the dissertation points the way to the most exciting possibilities of surgical advance in the coming decades.

The Neurologic Examination. By Russell N. De Jong, M.D., Professor of Neurology and Chairman of Department of Neurology, University of Michigan Medical School. Second edition. 9¾ × 6¾ in. Pp. 1078 + xv, with 368 illustrations. 1959. London: Pitman Medical Publishing Co. Ltd. £7.

The second edition of this large and comprehensive work has been very thoroughly revised and all the new neurological material has been incorporated in this volume. The author, whose extensive clinical background has enabled him to set forth in a lucid style a detailed and practical approach to the examination of the nervous system, has included in this book all the various recent laboratory investigations—and they are many.

Neurology is a difficult branch of medicine, but it is books of this calibre that make the examination of the neurological patient easy.

There can be little doubt that the second edition of this book will prove as popular as the first.

Operative Surgery. Progress Volume 1958. Edited by Charles Rob, M.C., M.Chir., F.R.C.S., Professor of Surgery, St. Mary's Hospital, London; and Rodney Smith, M.S., F.R.C.S., Surgeon, St. George's Hospital, London. 10¾ × 8¼ in. Pp. 100 + xiv, fully illustrated, and with the Indices to volumes 1–8. 1958. London: Butterworth & Co. (Publishers) Ltd. 60s.

The progress volume of this work on operative surgery contains some very practical and interesting articles. Alan Hunt gives an excellent article on the removal of a large or adherent spleen; the illustrations depicting the various stages of the operation are admirable.

A. L. D'Abreu describes the operation of aortic valvotomy in a very practical way; while I. A. Donaldson writes on the operative treatment of recurrent abortion.

The general index of the eight volumes of this work is not only comprehensive but is very practically prepared and accurate. This index alone makes the volume invaluable for ready reference to the whole of the volumes.

The Basic and Clinical Research of the New Antibiotic Kanamycin. Edited by Maxwell Finland. 9 × 6 in. Pp. 391, illustrated. 1958. New York: New York Academy of Sciences. $5.00.

This symposium comprises an account of a new antibiotic derived from actinomycetes which is active against the tubercle bacillus, staphylococci, and other organisms. The history of its production, preparation, and chemical purification is given in some detail. Later come purely chemical and pharmacological studies and its *in vitro* effect upon organisms. The spectrum of activity has been tested against neomycin. The half-life of the activity of kanamycin is found to be relatively short—namely about five hours—but its relatively high concentration in the urine after intramuscular injection would suggest that it might be valuable in urinary infections. Kanamycin is found to be bactericidal for staphylococci, 62 per cent of *Salmonella* and *Shigella*, and 90 per cent of coli-aerogenes cultures. Streptococci and pseudomonas cultures were not found to be sensitive. Three papers describe experiments performed on small laboratory animals and the rest of the symposium deals with the clinical application of this substance. As with streptomycin, kanamycin affects the eighth cranial nerve, and a warning is given not to exceed a total dose of about 50 g. Nephrotoxic effects have also been recorded, and during administration a close watch should be kept on the urinary output. Kanamycin should be given parenterally because of its defective absorption from the gastro-intestinal tract. Dosage is 1·5–2·0 g. daily. Injections should be given at intervals of eight to twelve hours.

This symposium, which should be studied by any clinician who contemplates the use of this antibiotic, suggests that kanamycin may be prescribed with caution in the treatment of staphylococcal infections, certain cases of tuberculosis, particularly of the renal tract, and in order to sterilize the bowel.

Surgical Convalescence. Edited by F. Curtis Dohan. 9 × 6 in. Pp. 157, illustrated. 1958. New York: New York Academy of Sciences. $4.00.

This monograph contains some useful information regarding the biology of surgical convalescence. Francis Dr. Moore, of Boston, contributes an excellent chapter dealing with this theme and considers that there are four phases of convalescence. These four phases are: (1) injury; (2) turning point; (3) spontaneous nitrogen anabolism—strength; and (4) fat redeposition—the fat gain phase.

Moore considers that the Darwinian concept of survival of the fittest truly finds its expression in the biological sequences involved in survival after injury.

Paul Hawley has written a most useful and practical chapter on the sociological importance of convalescence; in this article he stresses the usefulness of rehabilitation during the early stages of convalescence.

This monograph will interest all surgeons who have the interests of their patients at heart, and are keen to get them back to a normal working life as soon as possible.

Contributions of the Physical, Biological and Psychological Sciences in Human Disability. Edited by Renato Contini. 9 × 6 in. Pp. 160, illustrated. 1958. New York: New York Academy of Sciences. $3.50.

It is claimed that the physical engineer or scientist can contribute towards the betterment of the lot of the injured human being in three ways: by applying the laws of mechanics to the problems of leverage and momentum operating in the human organism; by devising electronic and optical recording instruments so that a greater precision is attained; and by the manufacture of prostheses of sound mechanical design. This symposium deals with the problem of co-operation between engineers and therapists under these headings. A taste of the quality of this book can be derived from a quotation from the first page: "... human bone has a tensile strength of the order of 20,000 p.s.i., a compression strength of the order of 25,000 p.s.i., an elasticity modulus of close to 3×10^6 p.s.i., and a specific gravity of about 1·9". With the exception of the last few words most surgeons would be sent hurrying to their physics text-books if they were to have the remotest idea of what all this meant. The problems of prostheses are discussed in relation to these physical factors. Later the psychological effects of

amputation are described in relation to the Rorschach test, on which a faithful reliance is reposed.

There is a full discussion on methods of stimulating 'inter-disciplinary research' and the difficulties which are encountered. Various abnormalities of gait have been analysed by mechanical, photographic, and electromyographic techniques.

This work provides a curious hotch-potch of information on the psychological and mechanical problems associated with the rehabilitation of the injured—especially the amputee. It would be a useful book of reference for those engaged in research in this field.

Lesions of the Lower Bowel. By RAYMOND J. JACKMAN, M.D., M.S. in Proctology, Section of Proctology, Mayo Clinic, and Associate Professor of Proctology, Mayo Foundation, Graduate School, University of Minnesota. 9×6 in. Pp. 347+xxxviii, with 56 illustrations. 1958. Springfield, Ill.: Charles C. Thomas. (Oxford: Blackwell Scientific Publications.) £5 17s. 6d.

THIS book covers the surgical aspects of diseases of the lower part of the large bowel and the rectum. Quite naturally the greater part of the book is devoted to the treatment of malignant disease of the rectum.

When it is considered that about 70 per cent of all organic diseases of the large intestine—inflammatory, benign, and malignant—occur in the distal portion of that structure and therefore can be diagnosed more readily with the 25-cm. proctoscope than by any instrument or method, it is surprising that it is not used more often.

The author rightly stresses the great importance of a proctoscopic examination in all cases of rectal bleeding.

One of the features of this monograph is the excellent series of coloured plates, which are really beautiful.

The book sets out the methods which are in use in the proctological section of the Mayo Clinic.

Cancer of the Pharynx, Larynx and Œsophagus and its Surgical Treatment. By RONALD W. RAVEN, O.B.E. (Mil.), T.D., F.R.C.S., Joint Lecturer in Surgery, Westminster Medical School, University of London. 9½×6½ in. Pp. 286+xiv, with 189 illustrations. 1958. London: Butterworth & Co. (Publishers) Ltd. 67s. 6d.

THIS comprehensive work is based on the clinical and operative experience of the author over many years. The book is well written and beautifully illustrated, and well documented with references. It deals exhaustively not only with the anatomy and pathology of the upper part of the foregut, but with precancerous conditions, and the clinical picture of the disease.

The operative detail and the various operative techniques used in the treatment of cancer in these regions are well described and illustrated. The value of radiotherapy in all its many forms in the treatment of malignant disease of these organs is reviewed.

This book is the most up-to-date and exhaustive work that has so far been produced and it will remain the reference volume on cancer of the pharynx, larynx, and œsophagus for some time to come.

The Collected Papers of Hugh Trumble. Edited by LEONARD COX, M.D., R. S. LAWSON, F.R.C.S., and T. E. LOWE, M.D. Pp. 300. 1957. Melbourne University Press. 84s.

THIS work is a gesture of homage to a much revered associate of many years from his colleagues of the Alfred Hospital, Melbourne. It consists of a series of papers on Orthopædic Surgery, the Surgery of Tuberculosis, of the Autonomic Nervous System, of Intracranial Growths, and finally of General Surgery. These date from 1923 to 1951 and show a wide and discriminating interest in all the subjects treated. Some have appeared in the BRITISH JOURNAL OF SURGERY, but most in the *Medical Journal of Australia*; and it is therefore particularly plesant to have them collected here in such a handsome volume.

Of special interest are the papers on the fixation of the hip-joint by means of an extra-articular bone-graft, which has been adopted as standard in orthopædic surgery. In the section on Neurosurgery there are five articles well worth study.

The work is well produced with excellent binding, good type, and first-rate illustrations.

Neo-natal Paediatrics. Edited by W. R. F. COLLIS, M.D., F.R.C.P., F.R.C.P.I., D.P.H., Director of Department of Paediatrics, Rotunda Hospital, Dublin. 8½ × 5½ in. Pp. 301 + xiv, with 33 illustrations. 1958. London: William Heinemann Medical Books Ltd. 30s.

THIS book is a product of the Dublin School of Medicine, twenty of the twenty-six contributors working in the hospitals of that city. The editor, Dr. W. R. F. Collis, is Director of the Department of Pædiatrics at the Rotunda Hospital, and his aim has been to cover all aspects of the care of the newborn. In this he has succeeded and, at the same time, has presented a strong case for the more general adoption of units for the nursing of these children. Such a Unit exists at the Rotunda Hospital and is staffed not only by pædiatricians but also by a junior member of the obstetric staff.

All will agree that the problems associated with newborn babies are not adult conditions scaled down, but a result of the infant's special anatomy and physiology. This is everywhere stressed in the book, prominence being given to differences in renal function and electrolyte balance.

For the surgical reader the book contains much that is interesting. The increasing use of surgical methods to treat previously incurable abnormalities is recognized, and the resulting drop in mortality appreciated. In such a small book covering a wide field, it is impossible to give more than brief accounts of conditions that are rarities for the majority of surgeons. The sections on pyloric stenosis and œsophageal atresia are lengthy, and correspondingly valuable. These conditions apart, the information tends to be brief and in the nature of surgical general knowledge. However, the book is written for pædiatricians and students; the surgeon will still need to refer to larger works.

In works of multiple authorship imbalance always exists, but the reviewer was unusually surprised to find five times more space allotted to ear, nose, and throat than to abdominal surgery.

The surgeon will benefit greatly by reading the medical sections, and the reverse undoubtedly holds true. Such a book leads to wider co-operation between specialists, an important consideration in a subject that embraces many specialities.

Injuries and Surgical Diseases of the Ischium. By HENRY MILCH, M.D., Attending Orthopedic Surgeon, Hospital for Joint Diseases, New York. 10×6½ in. Pp. 163+x, with 106 illustrations. 1959. London: Pitman Medical Publishing Co. Ltd. £4 4s.

THIS monograph has been written on a very specialized and confined subject—namely, the ischium. It is only by reading this book that the reviewer has been brought in contact with the many and varied injuries and diseases which may occur in this small portion of the skeleton. It

seems that ischial decubitus ulcers are more common in America than in this country. Tumours of the ischium range almost over the whole field of bone tumours from osteoclastoma to osteoid osteoma, and from Ewing's tumour to secondary sarcoma and carcinoma.

One of the features of a monograph is that it is a reference volume containing all that is known on the subject in question, and this may certainly be said of Dr. Milch's book.

Urology in Outline. By T. L. CHAPMAN, Ch.M., F.R.C.S. (Eng.), F.R.F.P.S. (Glas.), Honorary Clinical Lecturer in Urology (University of Glasgow), and Urological Surgeon, Victoria Infirmary, Glasgow. 8¾ × 6 in. Pp. 176 + viii, with 138 illustrations. 1959. Edinburgh and London: E. & S. Livingstone Ltd. 27s. 6d.

MOST students have a better visual than auditory memory, and those who have seen Mr. Chapman's previous cartoon films have been impressed by their value for teaching. He has now extended their scope in this book, which covers the essentials of an elementary knowledge of urology in a series of simple line drawings with a minimum of text. It will make life easier for both students and teachers and it can be well recommended.

Tumors of the Lungs and Mediastinum. By B. M. FRIED, M.D., F.C.C.P., Associate Attending Physician, Montefiore Hospital, New York. 9½ × 6 in. Pp. 467, with 231 illustrations. 1959. London: Henry Kimpton. £5.

CANCER of the lung has increased consistently ever since the early twenties, until to-day it is the commonest form of cancer in the male.

This monograph, which is dedicated to the memory of Evarts A. Graham, covers the whole field of lung cancer and is illustrated with numerous photographs, photomicrographs, and radiographs. Tumours of the thymus, terato-dermoids, and cysts of the mediastinum are also described and illustrated.

Dr. Fried has been studying cancer of the lung for over thirty years, both from the clinical point of view and from material from the post-mortem room; he therefore speaks with authority. The more the clinician studies the ultimate fate of his cases the more mature he becomes, and Dr. Fried's clinical acumen is very evident in this book.

An excellent monograph.

Treatment of Cancer and Allied Diseases. Volume I, Principles of Treatment. Edited by GEORGE T. PACK, M.D., F.A.C.S., and IRVING M. ARIEL, M.D., F.A.C.S. 10 × 6¾ in. Pp. 646 + xxii, with 505 illustrations. 1959. London: Pitman Medical Publishing Co. Ltd. £8.

THIS comprehensive volume, the first to be completed in a series of nine volumes, covers a very large field. It is devoted exclusively to the clinical aspects of cancer management. Each section is written by an expert in his or her particular branch of cancer treatment, and the contributors come from both sides of the Atlantic. The illustrations throughout the book are good and well produced, especially the photomicrographs. The important problems of the microscopical grading of cancer and the value of biopsy in tumour diagnosis are well presented and discussed.

The clinical application of radioactive isotopes is dealt with in a very practical and interesting manner.

Hormone therapy and chemotherapy and the general care of the cancer patient are set out in a very proficient way.

We look forward to seeing the succeeding volumes of this important work.

Surgery in World War II—Neurosurgery, Volume I. Editor-in-Chief, Colonel JOHN BOYD COATES, jun., M.C. Prepared and published under the direction of Major General S. B. HAYS, Surgeon General, United States Army. 9¾ × 6½ in. Pp. 466 + xx, with 103 illustrations. 1958. Washington, D.C.: Office of the Surgeon General, Department of the Army. $5.00.

THIS volume deals with administrative considerations and head injuries in war casualties in the American Army in World War II. Every aspect of this vast problem is carefully considered and is in marked contrast to the treatment of head injuries in World War I. The great contrast in mortality rates in the two great wars is remarkable.

One reason for the remarkably low morbidity and mortality rates for neurosurgical injuries in World War II was the efficient administrative set-up, which enabled the professional skills of all concerned with the care of these casualties to be employed to the best advantage. The administrative section of this volume tells in detail the story of the establishment and operation of neurosurgical centres specially equipped and staffed with the best neurosurgical talent available. The casualties concentrated in these centres were thus treated not only competently but also with the most efficient possible use of specialized personnel and equipment.

The second part of this volume deals with the management of head injuries in World War II. The fundamental procedure of débridement was supplemented by improved techniques, including the bold use of delayed débridement and re-débridement; modern techniques of resuscitation; and chemotherapy and antibiotic therapy.

This comprehensive volume will interest all neurosurgeons and neurologists because there is much in this story of military neurosurgery which is applicable to peacetime practice.

We look forward to seeing Volume II, which deals with injuries of the spinal cord and of the peripheral nerves.

The Recovery Room. A Symposium. By JOHN ADRIANI, M.D., Professor of Surgery, School of Medicine, Tulane University; and JOHN B. PARMLEY, M.D., Instructor in Surgery, School of Medicine, Tulane University. 8½ × 5½ in. Pp. 123 + xii, with 17 illustrations. 1959. Oxford: Blackwell Scientific Publications. 32s. 6d.

RECOVERY rooms are found in all hospitals in the United States, but are far from common in English hospitals. However, some of our hospitals have a post-anæsthetic recovery room adjoining the operating theatre. Thoracic surgeons consider that such recovery rooms are essential for their cases.

In this small monograph some forty-five authorities from the field of anæsthesia, surgery, nursing, and hospital administration discuss the proper use of the recovery room and its place in the efficient running of the hospital. These authorities have certainly made a very definite plea for recovery rooms, and no doubt when some of our old hospitals are rebuilt, recovery rooms will be installed.

Orthopædic Nursing. By MARY POWELL, S.R.N., M.C.S.P., Orthopædic Nursing Certificate, Matron, Nuffield Orthopædic Centre (Wingfield Morris Orthopædic Hospital), Oxford. Third edition. 8½ × 5¼ in. Pp. 464 + xii, with 279 illustrations. 1959. Edinburgh and London: E. & S. Livingstone Ltd. 27s. 6d.

THE fact that the second edition of this book appeared less than three years ago speaks for the popularity of this work. The third edition is beautifully illustrated, and it is written

in a practical yet lucid style. This book should prove of value not only to nurses and physiotherapists but also to medical students.

An excellent production.

Cardiac Arrest and Resuscitation. By HUGH E. STEPHENSON, jun., M.D., Professor and Chairman, Department of Surgery, University of Missouri School of Medicine, Columbia, Missouri. $9\frac{3}{4} \times 6\frac{1}{4}$ in. Pp. 378, with 31 illustrations. 1958. St. Louis: C. V. Mosby Company (London: Henry Kimpton). 90s.

THIS book appears at an opportune time when surgeons and anæsthetists the world over are deeply interested in this all too frequent condition. Hospitals on both sides of the Atlantic have been at pains to provide emergency equipment which can be used at a moment's notice.

Professor Stephenson has certainly presented the medical profession with an excellent monograph which contains a wealth of information that it would be very difficult to find elsewhere.

The operative technique for dealing with cardiac arrest is well described and illustrated. The pros and cons of opening the pericardium are well debated and the reader is left in no uncertainty as to what the author himself advises.

In these days of operations on septal defects in the heart this book will prove of real value.

A most comprehensive bibliography is to be found at the end of this book and this bibliography itself should prove of positive value and make the book more useful for reference purposes.

Lectures on Epilepsy. Edited by A. M. LORENTZ DE HAAS, Medical Director of the Epilepsy Centre, "Meer en Bosch", Heemstede, Netherlands. $8\frac{3}{4} \times 5\frac{3}{4}$ in. Pp. 172+viii. 1958. Amsterdam: Elsevier Publishing Co. (London: D. Van Nostrand Co. Ltd.). 24s.

THESE lectures now produced in book form were given in 1957 at Heemstede on the occasion of the seventy-fifth anniversary of the Epilepsy Centre of 'Meer en Bosch'. The lectures fall into definite groups. Those dealing with 'temporal lobe epilepsy' in which neurosurgery may be required and the wide variety of neurosurgical techniques in vogue are described well.

A large section of this monograph is devoted to the psychic disturbances in epileptics; while a full discussion is given dealing with serial electro-encephalographic investigations during psychotic episodes in epileptic patients and during schizophrenic attacks.

The last part of the book deals with the clinical and electro-encephalographic findings in epileptic patients with episodic mental disorders.

The neurosurgeon will find much to interest him in this book.

The Year Book of General Surgery, 1958–1959. Edited by MICHAEL E. DE BAKEY, B.S., M.D., M.S., with a section on Anæsthesia edited by STUART C. CULLEN, M.D. $7\frac{3}{4} \times 5$ in. Pp. 588, with 149 illustrations. 1958. Chicago: Year Book Publishers Inc. (London: Interscience Publishers Ltd.). 57s.

As one would expect, a large section of this year book is devoted to the subject of cardiovascular surgery, as there has been such an expansion of this branch of surgery during recent years. The value of vascular replacements is dealt with in a very thorough and practical way and the reader is given a good précis of the world literature.

Tissue transplantation is considered as a whole and it appears that world opinion is against homotransplanted tissue because of an immunological phenomenon.

Every branch of surgery is surveyed in this year book and there can be no doubt that it will prove as popular and useful as the previous editions.

The Year Book of Radiology, 1958–1959. Radiologic Diagnosis, edited by JOHN FLOYD HOLT, M.D., and FRED JENNER HODGES, M.D., Radiation Therapy, edited by HAROLD W. JACOX, M.D., and MORTON M. KLIGERMAN, M.D. $8\frac{3}{4} \times 5\frac{1}{2}$ in. Pp. 448, with 336 illustrations. 1958. Chicago: Year Book Publishers Inc. (London: Interscience Publishers Ltd.). 75s.

THIS year book contains some interesting abstracts on radiation hazards, especially the effects of gonadal exposure.

X rays play a part to-day in the diagnosis and treatment of many diseases in the various branches of medicine and surgery, and this great expansion is portrayed in this useful year book of radiology.

Tumours of the Bladder. Edited by DAVID M. WALLACE, O.B.E., M.S., F.R.C.S., Surgeon, St. Peter's, St. Paul's, St. Philip's Hospitals; Senior Lecturer, Institute of Urology, University of London. $9\frac{3}{4} \times 6\frac{1}{2}$ in. Pp. 352 + xvi, with 202 illustrations. 1959. Edinburgh and London: E. & S. Livingstone Ltd. 60s.

THIS book is an important landmark in our knowledge of bladder tumours; in it are collected the most modern views of urologists, pathologists, biochemists, radiotherapists, and statisticians on a subject which bids fair to provide a reasonable explanation of one facet of the cancer problem. The editor has enlisted the co-operation of an authoritative team, each an expert in his own branch, and has correlated their views to give a comprehensive account of the trends of current research and treatment.

Statistics show that although cancer of the bladder has not reached the status of a major cause of death, yet the mortality from it is increasing amongst males. There is a definite industrial risk and with an increasing number of new processes and new organic substances in use in industry a knowledge of industrial chemistry, and in particular of the compounds known or expected to be carcinogenic, becomes of paramount importance. In the screening of large numbers of workers by cytological examination of the urine the detection of microscopic hæmaturia is a practical possibility whilst the method of exfoliative cystology is too time-consuming. Either will give an indication for that most positive of all investigations, cystoscopy, and this, whilst impracticable for routine purposes on a large scale, must still be used in the follow-up of recurrent cases. The legal implications are described.

Experimental work in animals and clinical research in man have thrown light on the biochemical factors concerned in the origin of bladder tumours. Carcinogenic aminophenols given orally owe their activity to their metabolites, and some of these produce tumours when implanted directly into the bladder. Hydrolysis of the metabolic products of aromatic amines by the enzyme β-glucuronidase is responsible for the formation of the carcinogen in the urine, and this enzyme is found in excess in the urine of some patients with bladder cancer. Attempts to inhibit its activity by saccharolactone are on trial.

A plea is made for the standardization of pathological terms. The common tumours are papillary or solid; they can be graded by their histology and staged by their depth of spread in the bladder, and, whilst there is a continuous gradient of malignancy in the tumours encountered, this does not imply that a tumour can change its grade unless influenced by incomplete treatment.

The clinical assessment of a bladder tumour demands full investigation with modern instruments and is the basis for the selection of treatment. Endoscopic methods are the first choice in small or average-sized mucosal tumours; partial cystectomy is used where the site and extent of a solitary tumour make its wide excision possible. Re-implantation of the ureter does not appear to be in favour. Total and radical cystectomy are rarely used unless radiotherapy and conservative surgery have failed. Retention of the lower part of the prostate is said to preserve sexual function, although it carries an undoubted danger of recurrence in the prostatic urethra. For urinary diversion ureterocolic anastomosis is preferred to an ileal loop, provided that good follow-up and correction of biochemical complications is ensured. The methods of intracavitary, interstitial, and external beam irradiation are fully described, with their indications and complications.

The results of treatment in 1420 new cases seen since 1950 are subjected to detailed analysis according to stage; graphs and line charts give the survival of individual patients. Results in eleven other series are quoted for comparison, although such comparison is unrewarding because of differences in the methods of classification, and because the main survival table here gives only three-year results whilst most of others record five-year figures. The impression is that the results of treatment show little variation from others previously recorded.

We have nothing but praise for the splendid team-work which has gone into this volume. If it serves to bring about more uniformity in description and a realization of the problems involved and of the need for specialized treatment, it will have served its purpose.

The production bears the stamp of excellence of the house of Livingstone; it is well illustrated and reasonably priced.

Les Traumatismes du Thorax. By JEAN-CHARLES SOURNIA. 9½ × 6 in. Pp. 354, with 92 illustrations and 9 plates. 1958. Paris: Gaston Doin et Cie. 4,800 fr.

THE author of this book, who is Professor of Surgery at the French Medical School in Beirut, was formerly an assistant of Professor Paul Santy. He records no personal statistics but gives his reflections on a varied experience of chest injuries both at Lyon and in the Middle East "starting with a gun-shot wound in 1939 and ending with a camel-kick in 1957".

The book is primarily intended for surgeons who are unable to call on special thoracic surgical centres for help. Early chapters deal with basic anatomy and physiology, the disordered mechanism of the injured chest, and the dangers of retained bronchial secretions. Detailed descriptions are given of methods of chest aspiration, pleural drainage, tracheal intubation, external fixation of mobile areas of chest wall, and the techniques of thoracotomy and cardiac massage. The principles of physiotherapy are outlined. Major portions of the book deal with the effects of open and closed chest injuries, the section on injuries of the trachea and main bronchi being especially noteworthy. Good descriptions are given of the manifestations of the various injuries, with firm directions for management in the early days. Though this results in much repetition, it is never tedious and has the merit of keeping the basic principles well to the fore throughout. There is a short chapter on 'blast' injuries in which the author shows himself to be well acquainted with British experience in the Second World War. There is also a section devoted to chemical trauma of the respiratory tract and œsophagus.

The last section deals with the late effects of injuries and the assessment of disability. As the book is mainly concerned with early management, details of treatment are omitted from this part, but an excellent result from Professor Santy's Clinic following reconstruction of a ten-weeks-old traumatic stricture of the right main bronchus is illustrated.

In various places short references are made to tracheostomy and the use of mechanical respirators: more information giving the author's experience and views on their value in chest injuries would have been welcomed. Likewise it would have been helpful to have learned more of his experience with the operative fixation of mobile rib segments.

The book is well produced, but most of the radiographs are reproduced as positives and in some it is difficult to see the features described. Throughout the text there are occasional flashes of dry humour, and the work is brightened by contemporary illustrations of the deaths following chest wounding of famous historical personages. Among the crowd at the bedside of the Duc de Berry who died seven hours after transfixion of his right atrium, we see Dupuytren in attendance. We are shown also the assassination of the Empress Elizabeth of Austria, and we learn that she lived for fifty minutes after wounding and that at necropsy a hæmopericardium and a left ventricular wound were demonstrated by Auguste Reverdin. The French have a flair for this sort of writing; we are left wishing that Dr. Sournia had embellished the tantalizingly brief description of his own case of the Turkish smuggler who was shot through the chest from right to left at the level of the lung hila without damage to major structures.

This is an admirable book which many surgeons will wish to possess. Much of it will also interest those specializing in thoracic surgery.

Bone Tumors. By LOUIS LICHTENSTEIN, M.D., Chief Pathologist, General Medical and Surgical Hospital, Veterans Administration Center, Los Angeles. Second edition. 9¾ × 6½ in. Pp. 402, with 220 illustrations. 1959. St. Louis: The C. V. Mosby Company (London: Henry Kimpton). 90s.

THE second edition of this monograph on bone tumours has in part been re-written and the whole text thoroughly revised. Several new illustrations have been added.

Every aspect of bone tumour pathology has been covered and the book is an excellent reference volume.

Pathophysiology in Surgery. By JAMES D. HARDY, M.S.(Chem.), M.D., F.A.C.S. Professor and Chairman, Department of Surgery, and Director of Research, University of Mississippi Medical Center. 10 × 6¾ in. Pp. 704 + xx, with 278 illustrations. 1958. London: Baillière, Tindall & Cox Ltd. 152s.

THIS book appears at an opportune time, when physiology and pathology and the hinterland between the two are of real importance to the modern surgeon. Fifty years ago the portal of entry into the field of surgery was via the dissecting room, and anatomy was all-important; but to-day the entry is via the departments of physiology, biochemistry, and experimental pathology. It is because of these facts that this book becomes so important.

Professor Hardy has produced a book which will be of real value to all surgeons, since it deals with facts and considerations concerning the clinical conditions of their patients.

This volume is comprehensive and includes the physiology of injury, salt metabolism, renal function, fluid imbalance, surgical nutrition, surgical microbiology, thermal burns, physiological considerations in cancer, and radiation and radio-active isotopes. There is an interesting chapter on the surgical aspects of ageing.

As a ready reference book this monograph could not be bettered.

Hodgkin's Disease. Edited by ANTONIO ROTTINO. 9×6 in. Pp. 380, fully illustrated. 1958. New York: New York Academy of Sciences. $4.50.

THIS monograph is devoted to the important subject of Hodgkin's disease. It is a most comprehensive volume covering the whole large field of this disease, including the morphology, physiology, and metabolism of the cellular types.

It is a curious fact that although tremendous strides have been made in the treatment of many diseases yet very little has been discovered about Hodgkin's disease. There has been no dearth of research into this disease, yet all that can be said as far as treatment is concerned is that the discovery of the ameliorative effects of X rays and the mustard compounds are the only positive factors so far revealed.

This monograph is divided into four parts; part one is devoted to a detailed investigation into the lymphocyte; part two deals with the reticulum cell; part three is dedicated to cytology and aetiology; while part four is concerned with therapy.

The X-ray therapy in Hodgkin's disease only yields a 10 per cent 5-year survival rate, but better results are to be expected with the 2-million-volt therapy plant.

There is still the scope of chemotherapy to be considered and Sidney Faber, who contributes this section, considers that this will be increased greatly in the immediate future. We all sincerely wish that this may be so.

This monograph is a very useful reference volume concerning all aspects of Hodgkin's disease.

BOOK NOTICES

[The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest to our readers.]

Surgery of the Colon. By E. S. R. HUGHES, M.D., M.S.(Melb.), F.R.C.S.(Eng.), F.R.A.C.S., Hon. Surgeon, The Royal Melbourne Hospital, Melbourne. 9¾×6¾ in. Pp. 416+viii, with 234 illustrations. 1959. Edinburgh: E. & S. Livingstone Ltd. 63s.

Manuel de Traumatologie. By GEORGES RIEUNAU. 10½×7 in. Pp. 220, with 107 illustrations. 1959. Paris: Masson et Cie. 3000 fr.

Traité de Technique Chirurgicale. Volume VII. Abdomen. By JEAN QUÉNU, J. LOYGUE, and A. DUBOST. 9½×6½ in. Pp. 770+viii, with 526 illustrations. 1959. Paris: Masson et Cie. 7200 fr.

Konservative und chirurgische Behandlung angeborener und erworbener Herzfehler. By E. DERRA, Düsseldorf; O. BAYER, Berlin; and H. H. WALTER, Berlin. 8¼×5¾ in. Pp. 64+viii, with 25 illustrations. 1959. Stuttgart: Georg Thieme. D.M. 6.40.

Fractures et Luxations. By P. MATHIEU. 8¼×5 in. Pp. 211, with 103 illustrations. 1959. Paris: L'Expansion Scientifique Française. 1500 fr.

Atlas de Techniques Chirurgicales. By R. MICHEL-BECKET. 14¾×10¾ in. Pp. 580, with 1125 illustrations. 1958. Paris: C. Doin et Cie. 25,000 fr.

Physiology of Spinal Anesthesia. By NICHOLAS M. GREENE, B.S., M.A., M.D., Professor of Anesthesiology and Lecturer in Pharmacology, Yale University School of Medicine. 9×5¾ in. Pp. 195+xii, with 7 illustrations. 1958. Baltimore: The Williams & Wilkins Co. (London: Baillière, Tindall & Cox Ltd.). 48s.

Alfred Hospital Clinical Reports, 1958. Edited by R. S. LAWSON. 9¾×6 in. Pp. 108, fully illustrated. 1958. Melbourne: Alfred Hospital.

Clinical Neurosurgery, The Proceedings of the Congress of Neurological Surgeons, Washington, D.C., 1957. Volume 5. 9×5¾ in. Pp. 206+xx, illustrated. 1958. Baltimore: Williams & Wilkins Co. (London: Baillière, Tindall & Cox Ltd.). 64s.

Hermaphroditism, Genital Anomalies and Related Endocrine Disorders. By HOWARD W. JONES, jun., M.D., Associate Professor of Gynecology, Johns Hopkins University School of Medicine; and WILLIAM WALLACE SCOTT, M.D., Ph.D., Professor of Urology, Johns Hopkins University School of Medicine. 10½×7½ in. Pp. 456+xvi, with 466 illustrations. 1958. Baltimore: Williams & Wilkins Co. (London: Baillière, Tindall & Cox Ltd.). 128s.

The Pathology and Management of Portal Hypertension. By R. MILNES WALKER, M.S., F.R.C.S., Professor of Surgery, University of Bristol. 9×5¾ in. Pp. 113+viii, with 67 illustrations. 1959. London: Edward Arnold (Publishers) Ltd. 35s.

Chirurgie der Arterien. By Doz. Dr. K. KREMER. 9½×6½ in. Pp. 280+viii, with 150 illustrations. 1959. Stuttgart: Georg Thieme. D.M. 59.